MINISTRY OF TRANSPORT
VIETNAM

STUDY FOR
ITS INTEGRATION PROJECT
IN NORTHERN AREA OF VIETNAM

APPENDIX 1

- ITS BASIC OPERATION PLAN
- SYSTEM OPERATION/MANAGEMENT PLAN
- SYSTEM OPERATION/MANAGEMENT MANUAL

NOVEMBER 2015

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
METROPOLITAN EXPRESSWAY CO., LTD.
NEXCO EAST ENGINEERING CO., LTD.
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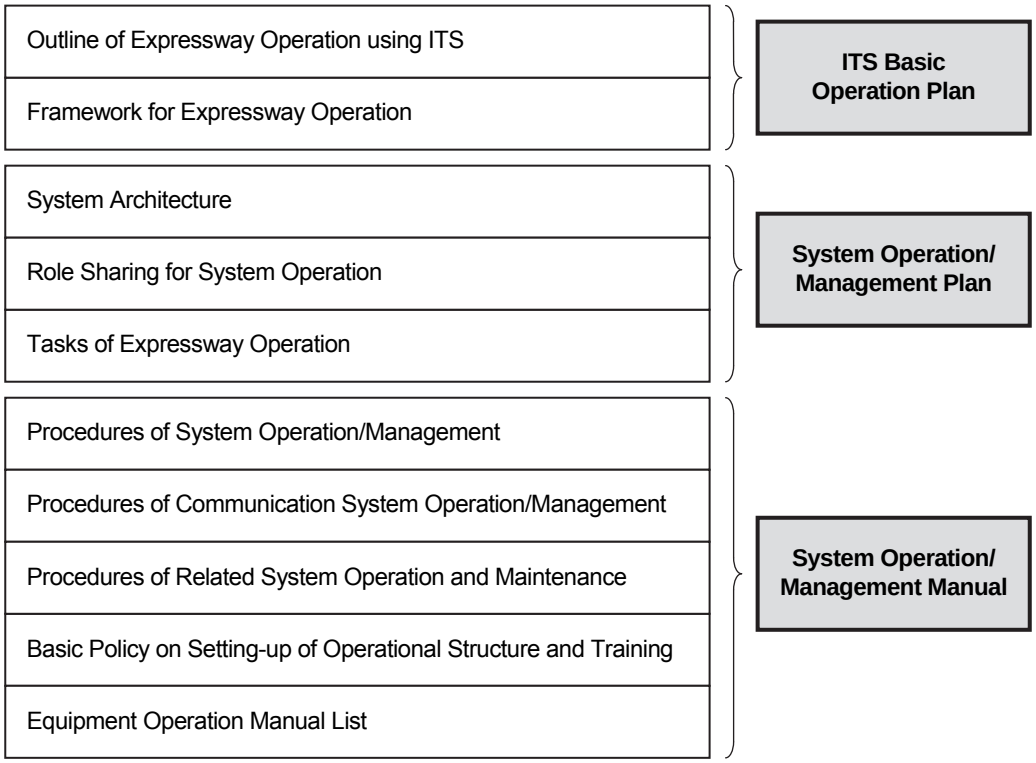
TABLE OF CONTENTS

1. Introduction

This volume of the Report includes the documents for operation of ITS for the expressways in Vietnam under the three Regional Main Centers, and that consists of the ITS Basic Operation Plan, the System Operation/Management Plan and the System Operation/Management Manual, which are organized as shown below.

Figure 1.1 Organization of the Documents



The procedures of system operation/management is to be developed by using Processing/ Screen Transition Diagrams based on the Event Tracing Diagrams shown in the chapter of tasks of expressway operation.

The equipment operation manual list is included in the System Operation/Management Manual; however, the specific documents of the Equipment Operation Manuals are to be prepared by suppliers, who provide equipment/software components.

2. Outline of Expressway Operation using ITS

The road management of expressway can be summarised as shown below in harmonization with Decree No.32/2014/ND-CP. It is assumed that ITS is to be applied to a part of road operation, which includes toll collection/management, traffic information/control, heavy truck control and communication system management.

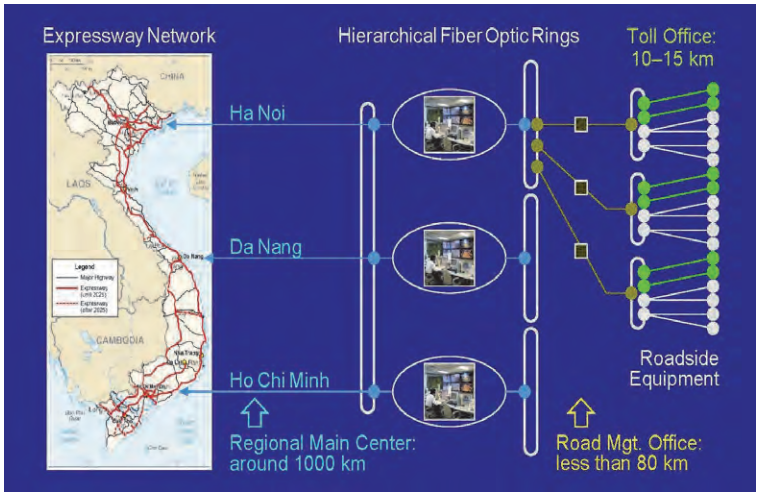
Table 2.1 Service Items of road management for Expressway

Operation	Maintenance
(a) Road Structure/Facility Management Cleaning-up, green space management, disaster recovery, energy and water supply and checkups of structure and facility in order to secure safety and comfort in road use.	Maintenance for restoring structure and facility to their original state of function and performance. - Pavement - Bridge - Tunnel - Semi-underground structure - Architectural structure - Mechanical equipment - Electrical equipment.
(b) Toll Collection/Management Toll collection from the road users and its management.	
(c) Traffic Information/Control Routine patrol, regulation against illegal vehicles and traffic control for safe/comfortable drive and smooth traffic flow. (d) Heavy Truck Control Control of weight and driving routes of heavy trucks.	
(e) Communication System Management Fiber optic cable network system operation and management	**Scope Applicable for ITS**

Source: VITRANSS2 Study Team

The structure/location of road operation offices is illustrated in the ITS Master Plan as below.

Figure 2.1 Structure/Location Outline of Road Operation Offices

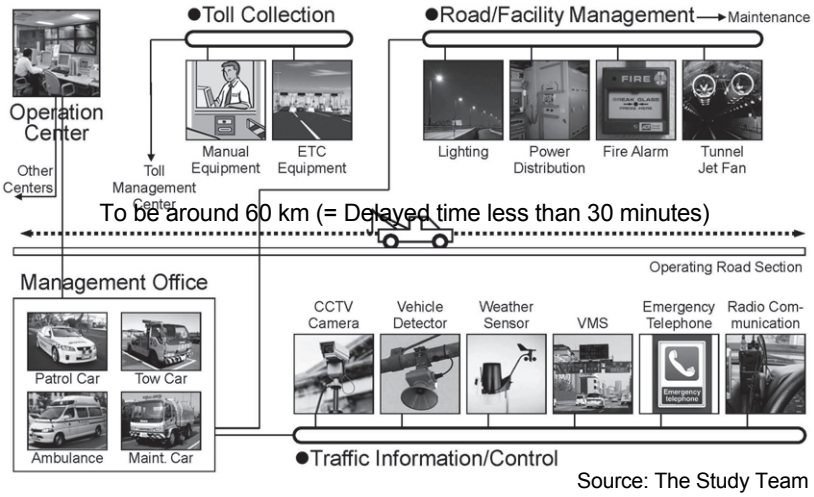


Classification	Functions/Locations
Regional Main Center	This center is to perform the functions of integration of the traffic control/management at the road management offices of respective expressway sections, and is to be located in the major cities such as Ha Noi, Da Nang and HCMC.
Road Management Office	This office is to perform all the functions of road management of an expressway section other than toll collection/management and heavy truck control, and at least one office is to be installed in each section. A communication node to integrate its jurisdiction is to be installed here.
Toll Office	This office is to perform the functions of toll collection/management and heavy truck control, and is to be installed at a tollgate to integrate the toll-booths. A communication node for integrating pieces of roadside equipment can be installed here.

Source: ITS Integration Project (SAPI) Study Team

Interchanges are to be arranged at 15 km intervals on the expressway network. The travel speed of a vehicle is to be more than 50 km/h and less than 120 km/h on the one-way lanes and an operation vehicle needs to be dispatched and arrive at an incident site within less than 30 minutes from the reception of emergency call. For such minimal service requirements, the interval of the road management offices is to be around 60 km.

Figure 2.2 Illustration of Equipment for Road Operation



Source: The Study Team

Basically, distance proportional tariff is to be adopted for the toll rate system of the expressways in Vietnam; however, flat tariff system also is to be available as the temporary toll rate system for a particular section.

Table 2.2 Conception of Toll Rate Table for Distance Proportional Tariff System

Toll Rate Table		Exit					
		Tollgate-1	Tollgate-2	Tollgate-3	Tollgate-4	Tollgate-5	…
Entrance	Tollgate-1	--	Rate for 1 to 2	Rate for 1 to 3	Rate for 1 to 4	Rate for 1 to 5	…
	Tollgate-2	Rate for 2 to 1	--	Rate for 2 to 3	Rate for 2 to 4	Rate for 2 to 5	
	Tollgate-3	Rate for 3 to 1	Rate for 3 to 2	--	Rate for 3 to 4	Rate for 3 to 5	…
	Tollgate-4	Rate for 4 to 1	Rate for 4 to 2	Rate for 4 to 3	--	Rate for 4 to 5	…
	Tollgate-5	Rate for 5 to 1	Rate for 5 to 2	Rate for 5 to 3	Rate for 5 to 4	--	…
	:	:	:	:	:	:	--

Source: The Study Team

The vehicle classification for expressway toll in Vietnam is defined in the Circular No.14/2012/ TT-BTC of MOF as shown below. The discussions in the Study are to be based on them.

Table 2.3 Vehicle Classification for Toll in Vietnam

Vehicle Class		Definition
Ordinary Vehicle	1	Cars with seats of 12 or less, trucks with a capacity less than 2 tons, mass transit buses
	2	Cars seats between 12 and 30, trucks with a capacity between 2 and 4 tons
	3	Cars with seats of 30 or more, trucks with a capacity between 4 and 10 tons
	4	Trucks with a capacity between 10 and 18 tons, 20ft-container lorries
	5	Trucks with a capacity of 18 tons or more, 40ft-container lorries
MOD Vehicle	6	Military vehicles in the missions
Police Vehicle	7	Public security vehicles in the missions

Note, MOD: Ministry of Defence

Source: ITS Standards & Operation Plan Study Team

3. Frameworks for Expressway Operation

3.1 General

The frameworks below closely related with system operation are to be mentioned only to clarify the preconditions necessary for the system analysis of ITS and the role sharing for system operation but not to define all frameworks of expressway operation.

For all services of expressway operation:

- Total Framework of Expressway Operation
- Framework for Service Level Control

For traffic information/control:

- Framework for Traffic Information/Control
- Framework for 113 Call & Police Car Dispatch
- Framework for 115 Call & Ambulance Dispatch
- Framework for Incident Notification to Road Operator
- Framework for Traffic Restriction & Incident Clearance
- Framework for Road/Traffic Monitoring
- Framework for Traffic Event Data Management
- Framework for Traffic Information Dissemination.

For nonstop toll collection:

- Framework for Toll Collection/Management
- Framework for Toll Settlement
- Framework for IC-Card Issuance/Operation
- Framework for OBU Registration/Management
- Framework for Toll Enforcement.

For heavy truck control and others:

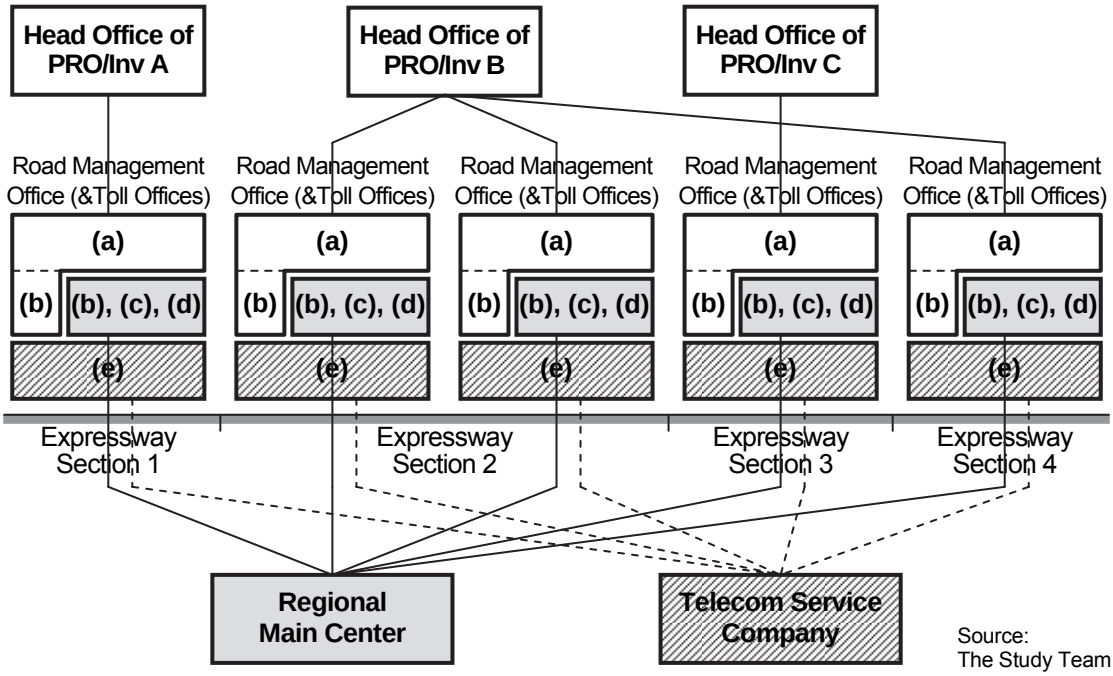
- Framework for Overloading Regulation
- Framework for Integrated Data Management
- Framework for Communication Network Management
- Framework for Radio Frequency Allocation
- Framework for System Maintenance.

3.2 Total Framework of Expressway Operation

The expressway network will be constructed/operated by section. So that, road structure/ facility management and toll collection/management are to be integrated under the head offices of the Public Road Owner or Investor (PRO/Inv). Traffic information/control and overloading regulation are to be integrated under the Regional Main Center. And communication network management are to be managed by the telecom service company. The service items of the expressway operation/maintenance are shown in the table below.

- Head office of PRO/Inv — (a) Road structure/facility management
  (b) Toll management.
- Regional Main Center — (c) Traffic information/control
  (d) Overloading regulation
- Telecom Service Company — (e) Communication network management.

Figure 3.1 Total Framework for Expressway Operation



(1) Roles of Expressway Management Agency

- Ownership/funding of the Regional Main Center
- Operation/maintenance of hardware/software of ITS
- Regulation on hardware/software in compliance with the ITS Standards.

(2) Roles of Public Road Owner or Investor (PRO/Inv, of Each Section)

- Ownership/funding of road structure/facilities other than ITS
- Ownership/funding of facilities of ITS
- Operation/maintenance of hardware/software of ITS (in the case of service contract)
- Toll management of an expressway section.

(3) Roles of Road Operator (of Each Section)

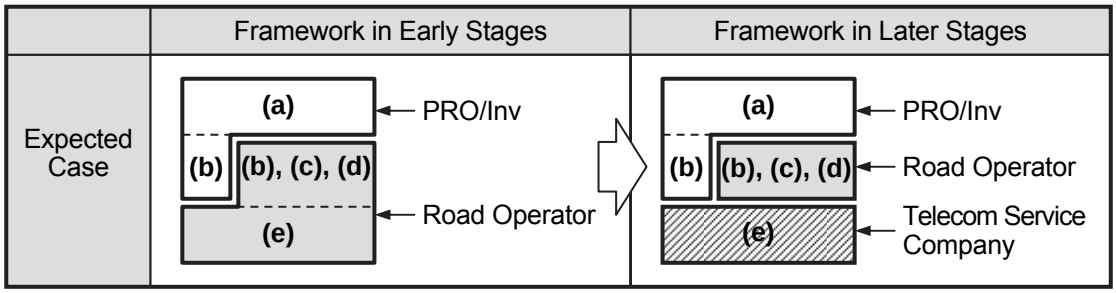
- Funding of facilities of ITS (in the case of concession contract)
- Operation/maintenance of hardware/software of ITS
- Traffic information/control of an expressway section
- Toll collection works of an expressway section
- Overloading regulation works of an expressway section.

(4) Roles of Telecom Service Company

- Funding/maintenance of facilities of trunk communication system of ITS
- Operation of trunk communication system of ITS.

In the early stage of ITS installation role sharing among organizations will not be established minutely; however, it will be broken into parts suitably for covering the whole service items of expressway operation in later stages. Total frame work can shift accordingly as shown in the figure below.

Figure 3.2 Expected Shift on Total Framework



Source: The Study Team

Burden sharing for the total framework above is to be defined as shown in the table below.

Table 3.1 Burden Sharing for Total Framework

	Cost	Revenue
Public Road Owner or Investor	- Implementation**/O&M cost of (a),(b) - Payment to the road operator - Payment to the Telecom Service Company***	- Toll revenue
Road Operator	- Implementation**/O&M cost of (b),(c),(d)	- Payment by the Public Road Owner or Investor
Telecom Service Company	- Implementation**/O&M cost of (e)	- Communication service revenue - Payment by the Public Road Owner or Investor ***

Note, ** : Assigned parts of construction cost
*** : This payment can be compensated by the permission to occupy the right of way for the telecom service company.

Source: The Study Team

3.3 Framework for Service Level Control

A set of Minimal Service Requirements shall be shown by MOT to the road operator in the process of making a concession or a permission for an expressway operation. The road operator is to be obliged to meet the Minimal Service Requirements through the concession directly with MOT or through the contract with the road operator, which corresponds to the assigned unit for expressway O&M defined in the Decree No.32/2014/ND-CP. The toll rate table for an expressway section is to be permitted by MOF and in case the road operator's achievement receives lower evaluation marks in reference to the Requirements penalty is to be imposed to the Public Road Owner or Investor (PRO/Inv) by MOT. The roles are to be shared as follows:

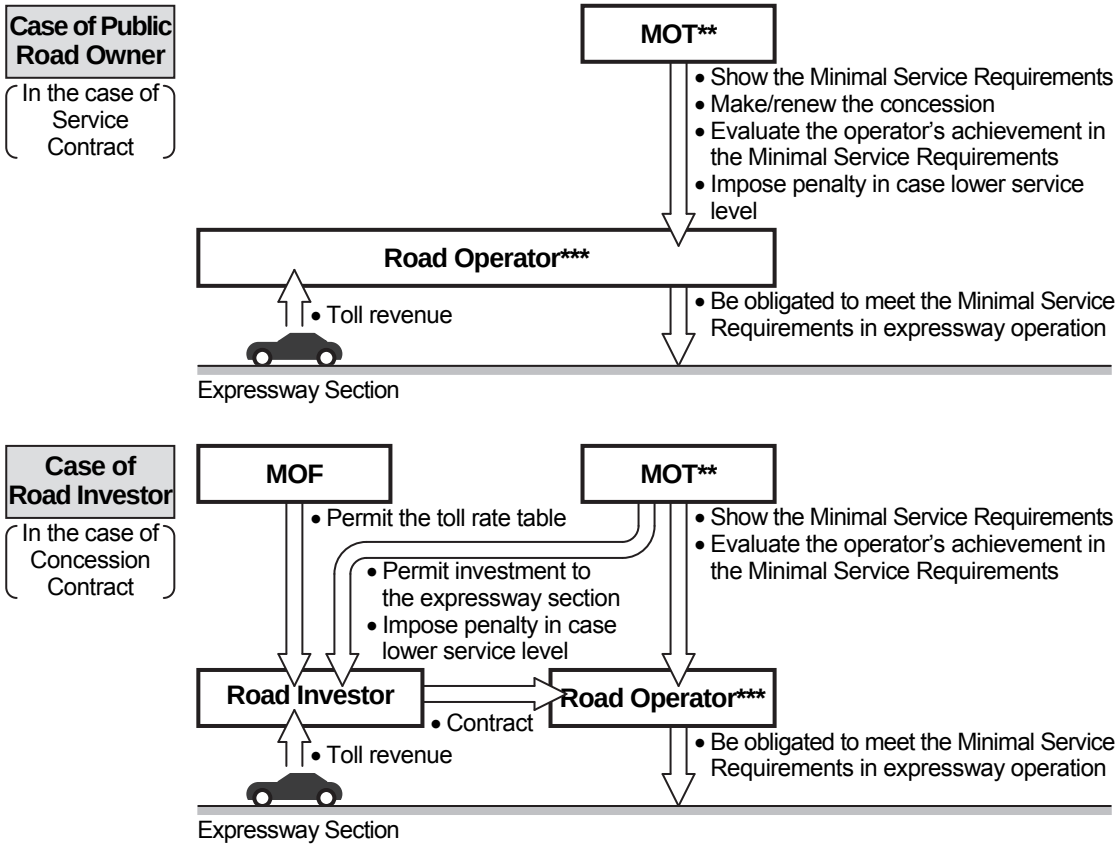
(1) Roles of Expressway Management Agency

- Evaluation of road operator's achievement in the expressway operation
- Check of the validity of toll revenue in comparison with the data of traffic.

(2) Roles of Public Road Owner or Investor (PRO/Inv, of Each Section)

- Funding/maintenance of road structure/facilities of an expressway section other than ITS
- Funding of facilities of ITS of an expressway section
- Toll management of an expressway section.

Figure 3.3 Framework for Service Level Control



Note, ** : Corresponding to the expressway management agency in the Decree No.32/2014/ND-CP, *** : Corresponding to the assigned unit for expressway O&M in the Decree No.32/2014/ND-CP.

Source: The Study Team

(3) Roles of Road Operator (of Each Section)

- Traffic information/control of an expressway section
- Toll collection works of an expressway section
- Overloading regulation works of an expressway section.

3.4 Framework for Traffic Information/Control

3.4.1 Key Framework

The framework for traffic control is shown in the following figure. The road management offices are to be integrated under the Regional Main Center controlled by the Expressway Management Agency in accordance with Decree No.32/2014/ND-CP. In this framework, expressway police offices are to be organized respectively for the expressway sections, which are the jurisdictions of road management offices. The roles are to be shared as follows:

(1) Roles of Expressway Management Agency

- Ownership/funding of the Regional Main Center
- Operation/maintenance of hardware/software of ITS
- Regulation on hardware/software in compliance with the ITS Standards
- Monitoring of the whole expressway network in the Regional Mai Center
- Guidance to the road management offices for integrated/prioritized information dissemination in the event of serious incident
- Decision to enforce a serious traffic restriction, such as closure, in consideration of the integration over different expressway sections
- Integrated data management.

(2) Roles of Public Road Owner or Investor (PRO/Inv, of Each Section)

- Ownership/funding of road structure/facilities other than ITS
- Ownership/funding of facilities of ITS
- Operation/maintenance of hardware/software of ITS (in the case of service contract).

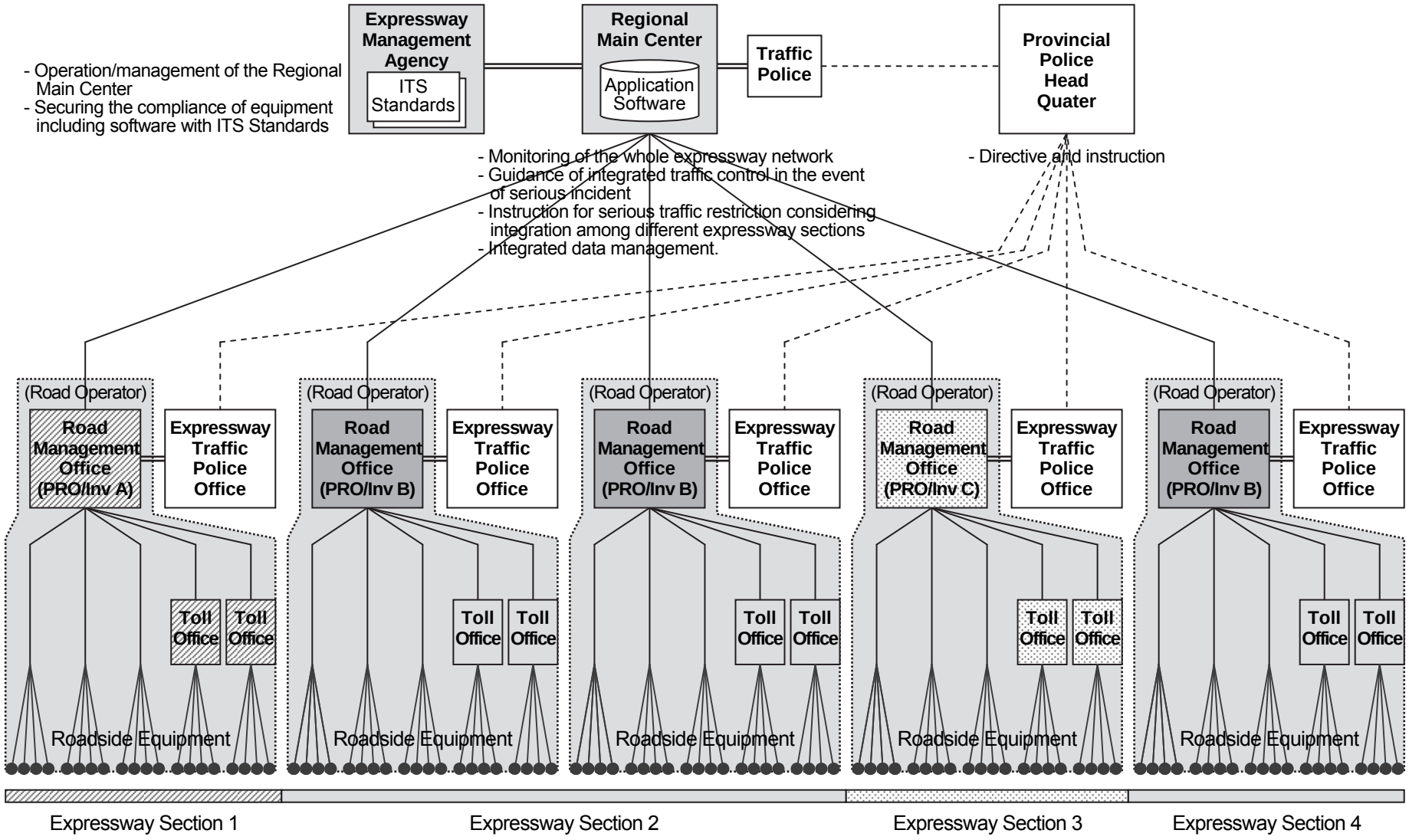
(3) Roles of Road Operator (of Each Section)

- Funding of facilities of ITS (in the case of concession contract)
- Operation/maintenance of hardware/software of ITS
- Acquisition of incident information through the special call number or detection by ITS
- Traffic information/control of an expressway section
- Dispatch of a patrol crew to the incident site
- Judgement on the gravity of an incident and the necessity to enforce a traffic restriction
- Traffic event data input at the road management office or roadside and sharing them with the Regional Main Center and other organizations.

Required Condition:

- Integration of the functions of expressway traffic control at road management offices under the Regional Main Center

Figure 3.4 Framework for Traffic Control



Source: The Study Team

3.4.2 Framework for 113 Call & Police Car Dispatch

A team of expressway police is to be assigned to each road management office with teams of the road operator and the ambulance service with an identical jurisdiction. In this framework, the three teams are to cooperate responding to 113 calls in case of traffic accidents, and roles are to be shared as follows:

(1) Roles of Expressway Management Agency

- Monitoring of the whole expressway network in the Regional Main Center
- Decision to enforce a serious traffic restriction, such as closure, in consideration of the integration over different expressway sections.

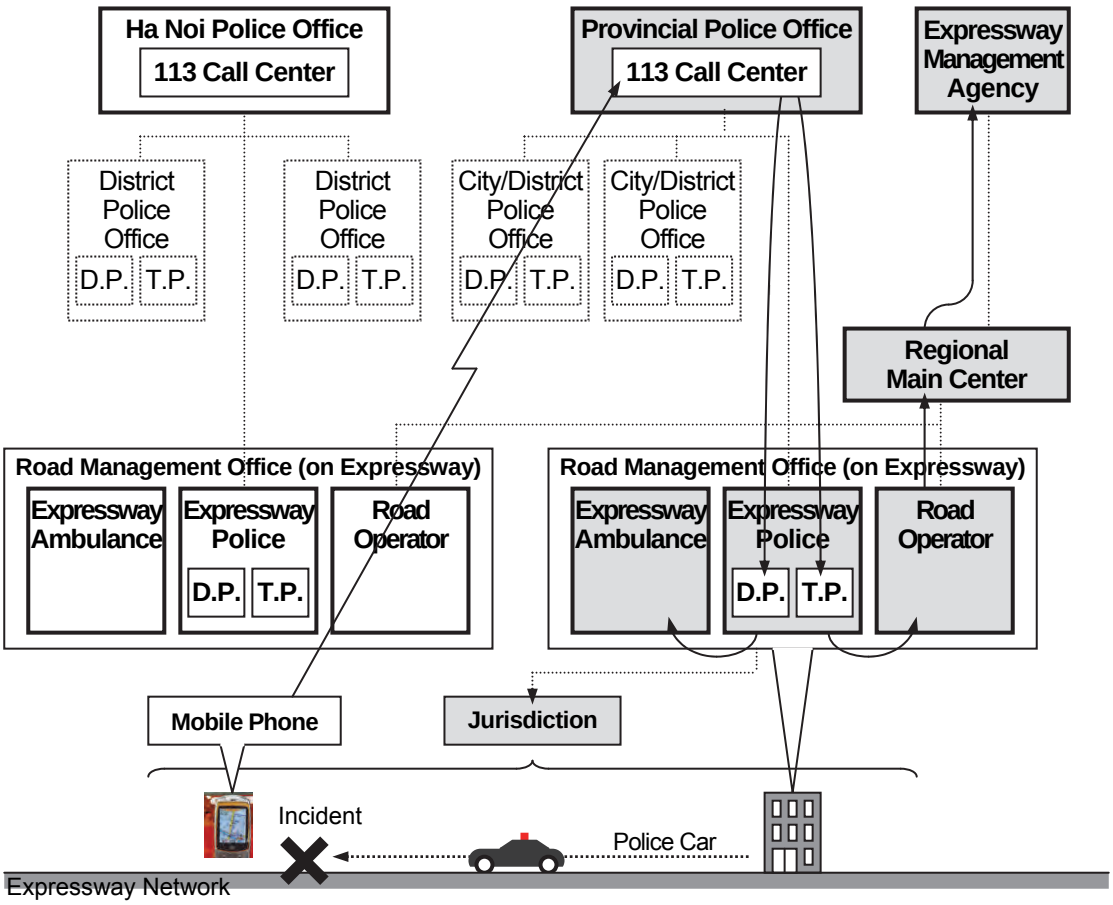
(2) Roles of Road Operator (of Each Section)

- Dispatch of a patrol crew to the incident site.

(3) Roles of Police Office (and Expressway Police)

- Reception of a 113 call and notification to the expressway police, the road operator and the expressway ambulance
- Dispatch of a police car to the incident site.

Figure 3.5 Framework for Police Car Dispatch



Note: D.P. : Detective police to be dispatched for traffic accidents with fatalities.
T.P. : Traffic police to be dispatched for traffic accidents without fatalities.

Source: The Study Team

3.4.3 Framework for 115 call & Ambulance Dispatch

A team of expressway ambulance is to be assigned to each road management office with teams of the road operator and the police with an identical jurisdiction. In this framework, the three teams are to cooperate responding to 115 calls in case of incidents, and roles are to be shared as follows:

(1) Roles of Expressway Management Agency

- Monitoring of the whole expressway network in the Regional Main Center
- Decision to enforce a serious traffic restriction, such as closure, in consideration of the integration over different expressway sections.

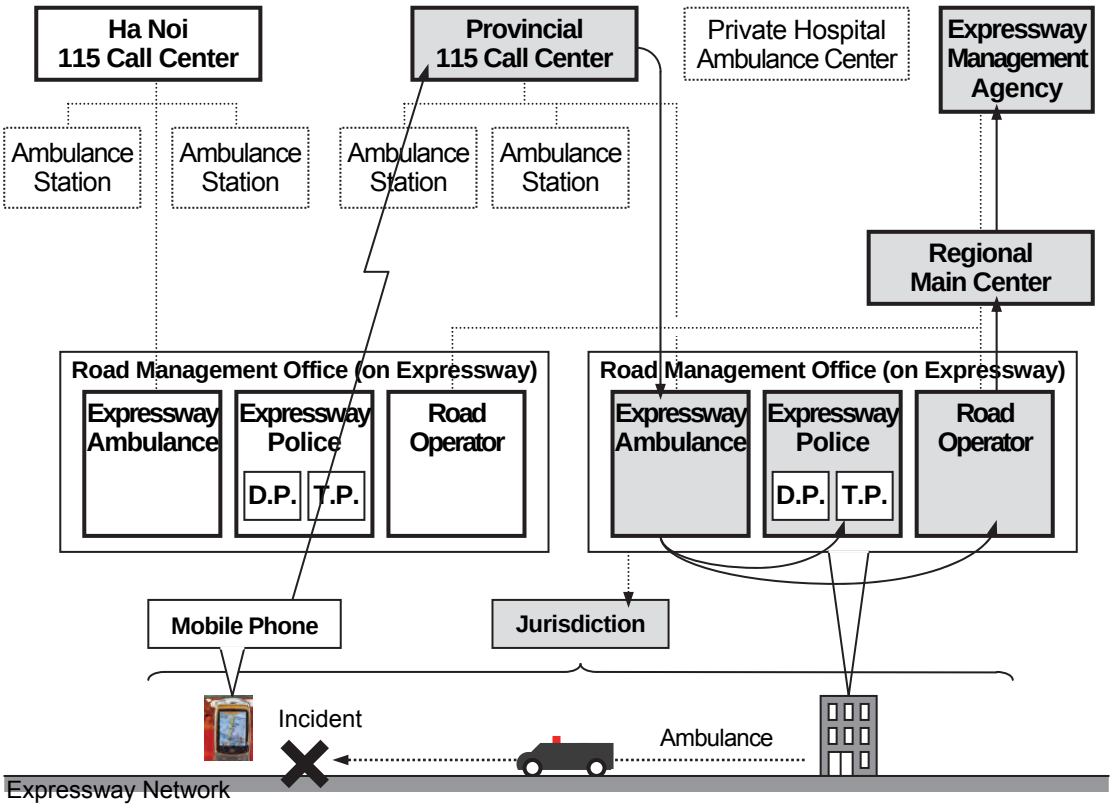
(2) Roles of Road Operator (of Each Section)

- Dispatch of a patrol crew to the incident site

(3) Roles of Ambulance Service (and Expressway Ambulance)

- Reception of a 115 call and notification to the expressway ambulance, the road operator and the expressway police
- Dispatch of an ambulance to the incident site

Figure 3.6 Framework for Ambulance Dispatch



Note: D.P. : Detective police to be dispatched for traffic accidents with fatalities
T.P. : Traffic police to be dispatched for traffic accidents without fatalities

Source: The Study Team

3.4.4 Framework for Incident Notification to Road Operator

The framework below is recommended for the road operator to receive notification at the occurrence of incident on the expressway network:

- Main part is to be formed by the Expressway Management Agency in MOT, the Regional Main Center and road management offices
- A special call number is to be prepared for the road operator to receive incident notification in accordance with Decree No.32/2014/ND-CP
- Incident notification can be received through one of the three ways: the special call number, 113 call and 115 call
- Road management offices are to cooperate with the Police offices
- Road management offices are to cooperate with the Ambulance Centers
- A team consist of the expressway police, the expressway ambulance and road operator is to be assigned to each road management office

(1) Roles of Expressway Management Agency

- Monitoring of the whole expressway network in the Regional Main Center
- Decision to enforce a serious traffic restriction, such as closure, in consideration of the integration over different expressway sections.

(2) Roles of Road Operator (of Each Section)

- Acquisition of incident information through the special call number or detection by ITS
- Dispatch of a patrol crew to the incident site.

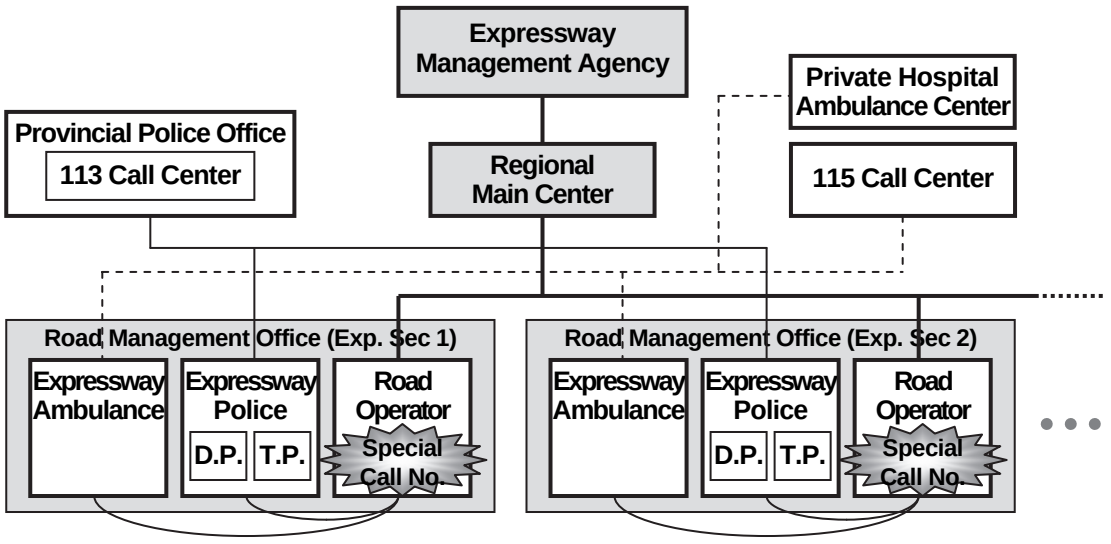
(3) Roles of Police Office (and Expressway Police)

- Reception of a 113 call and notification to the expressway police, the road operator.

(4) Ambulance Service (and Expressway Ambulance)

- Reception of a 115 call and notification to the expressway ambulance, the road operator.

Figure 3.7 Framework for Incident Notification to Road Operator



Note: D.P. : Detective police to be dispatched for traffic accidents with fatalities
T.P. : Traffic police to be dispatched for traffic accidents without fatalities

Source: The Study Team

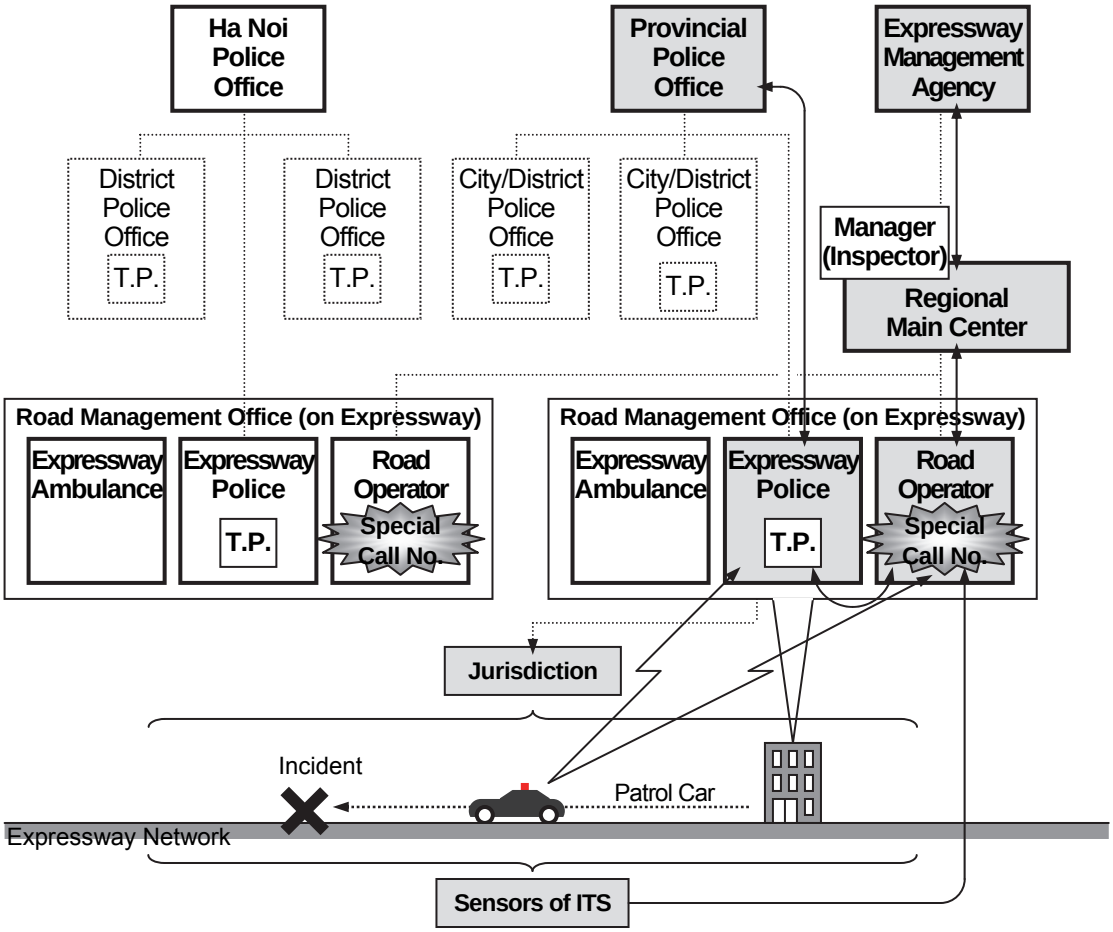
Required Condition:

- Decision and implementation of traffic restriction/closure under the responsible government agency
- Setting up of the special telephone number (without area code) for the emergency call at expressway
- Installation of a team to perform the functions of road operator, police and ambulance service in each road management office.

3.4.5 Framework for Traffic Restriction & Incident Clearance

The road operator is to acquire the information for deciding the traffic restrictions through the special call number or sensors of ITS and to make decisions to enforce the traffic restrictions on the expressway jointed with the police in the framework organized under the Expressway Management Agency. The roles are to be shared as follows:

Figure 3.8 Framework for Traffic Restriction



Note: D.P. : Detective police to be dispatched for traffic accidents with fatalities
T.P. : Traffic police to be dispatched for traffic accidents without fatalities.

Source: The Study Team

(1) Roles of Expressway Management Agency

- Monitoring of the whole expressway network in the Regional Main Center
- Decision to enforce a serious traffic restriction, such as closure, in consideration of the integration over different expressway sections.

(2) Roles of Road Operator (of Each Section)

- Acquisition of incident information through the special call number or detection by ITS
- Dispatch of a patrol crew to the incident site
- Identification of the situation/gravity of an incident
- Enforcement/removal of a traffic restriction
- Incident handling/clearance works.

(3) Roles of Police Office (and Expressway Police)

- Dispatch of a police car to the incident site.

3.4.6 Framework for Road/Traffic Monitoring

On the other hand, the Regional Main Center is recommended to exchange information/ data of traffic conditions/events on the national highways or the arteries around the exits of expressways with the Traffic Police Station or the VOV Center in the framework below. The roles are to be shared as follows:

(1) Roles of Expressway Management Agency

- Monitoring of the whole expressway network in the Regional Main Center
- Exchange monitored information/data of traffic conditions/events.

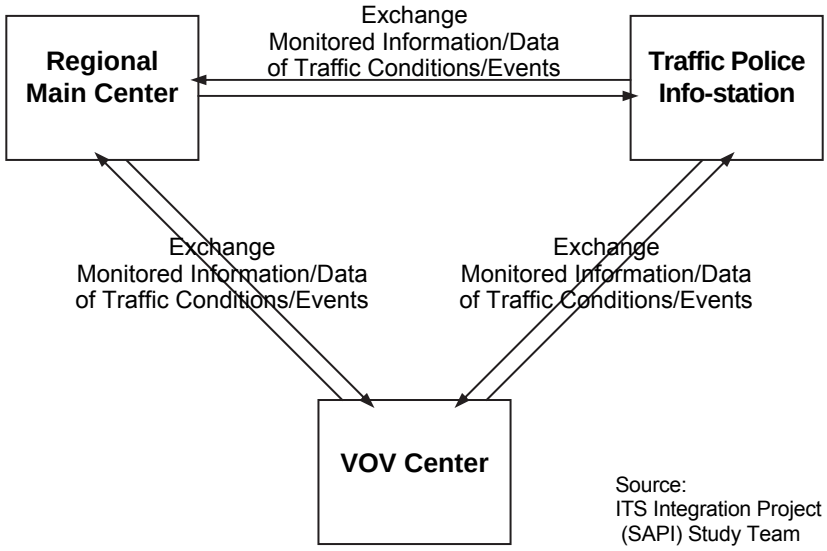
(2) Roles of Police Office (and Expressway Police)

- Exchange monitored information/data of traffic conditions/events.

(3) Roles of VOV Center

- Exchange monitored information/data of traffic conditions/events.

Figure 3.9 Framework for Road/Traffic Monitoring



3.4.7 Framework for Traffic Event Data Management

A traffic event data can be input at a road management office or roadside as well as the Regional Main Center. The validity of the data are to be monitored/checked at both the road management office and the Regional Main Center. Especially in case of expressway closure caused by an serious incident, the check is to be done for getting permission by the inspector in the Regional Main Center under the Expressway Management Agency.

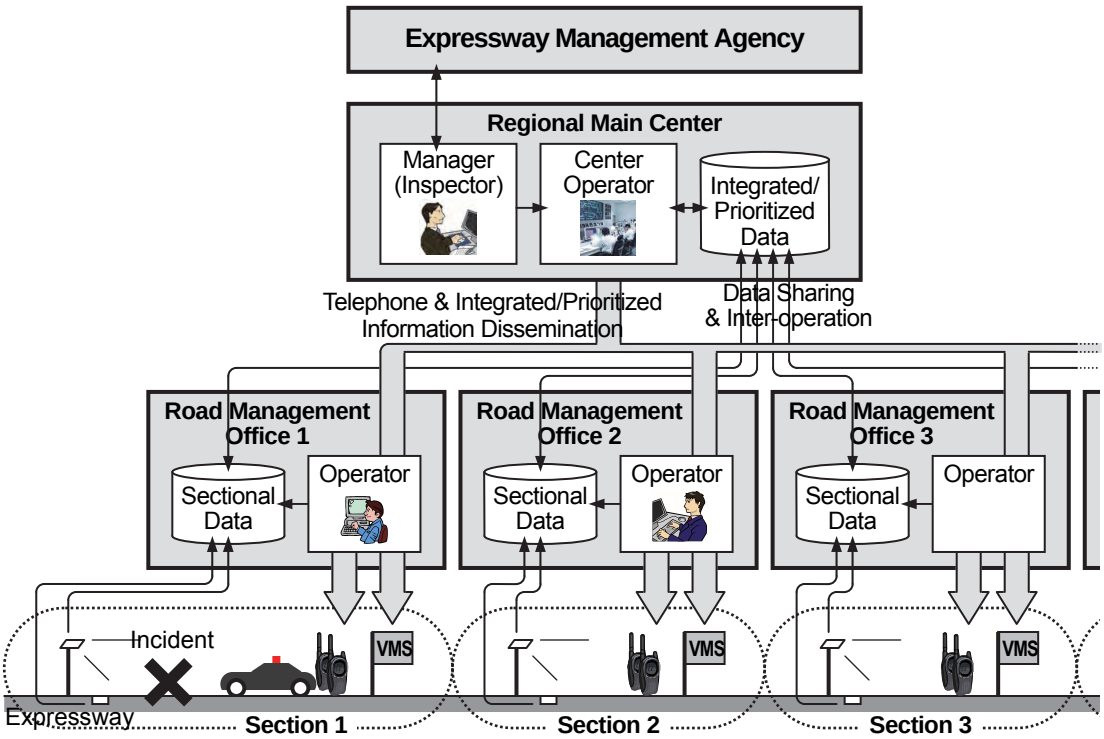
(1) Roles of Expressway Management Agency

- Regulation on hardware/software in compliance with the ITS Standards
- Monitoring of the whole expressway network in the Regional Main Center
- Guidance to the road management offices for integrated/prioritized information dissemination in the event of serious incident
- Decision to enforce a serious traffic restriction, such as closure, in consideration of the integration over different expressway sections.
- Integrated data management

(2) Roles of Road Operator (of Each Section)

- Acquisition of incident information through the special call number or detection by ITS
- Traffic information/control of an expressway section
- Dispatch of a patrol crew to the incident site
- Judgement on the gravity of an incident and the necessity to enforce a traffic restriction
- Traffic event data input at the road management office or roadside and sharing them with the Regional Main Center and other organizations.

Figure 3.10 Framework for Traffic Event Data Management



Source: The Study Team

3.4.8 Framework for Traffic Information Dissemination

Traffic Information, which consists of standardised messages and standardised data elements, is to be disseminated to organizations concerned through the Internet. The roles are to be shared as follows:

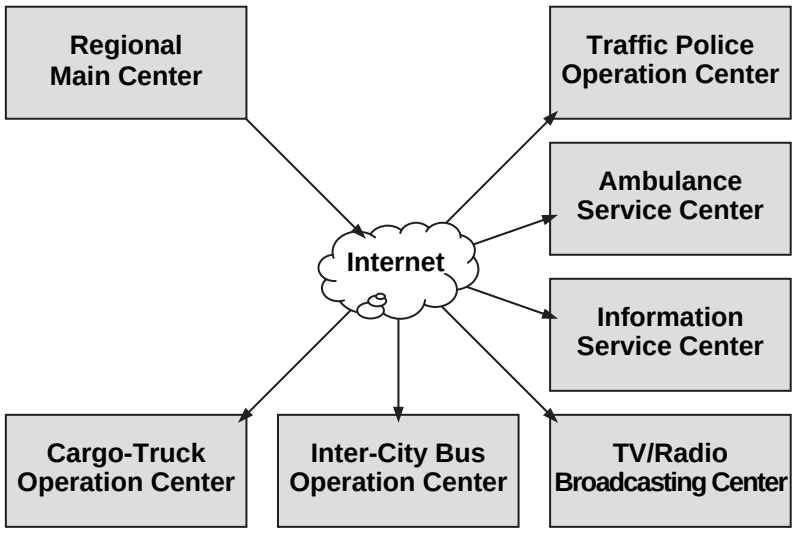
(1) Roles of Expressway Management Agency

- Monitoring of the whole expressway network in the Regional Main Center
- Integrated data management.

(2) Roles of Road Operator (of Each Section)

- Acquisition of incident information through the special call number or detection by ITS
- Judgement on the gravity of an incident
- Traffic event data input at the road management office or roadside and sharing them with the Regional Main Center and other organizations.

Figure 3.11 Framework for Traffic Information Dissemination



Source: ITS Standards & Operation Plan Study Team

3.5 Framework for Toll Collection/Management

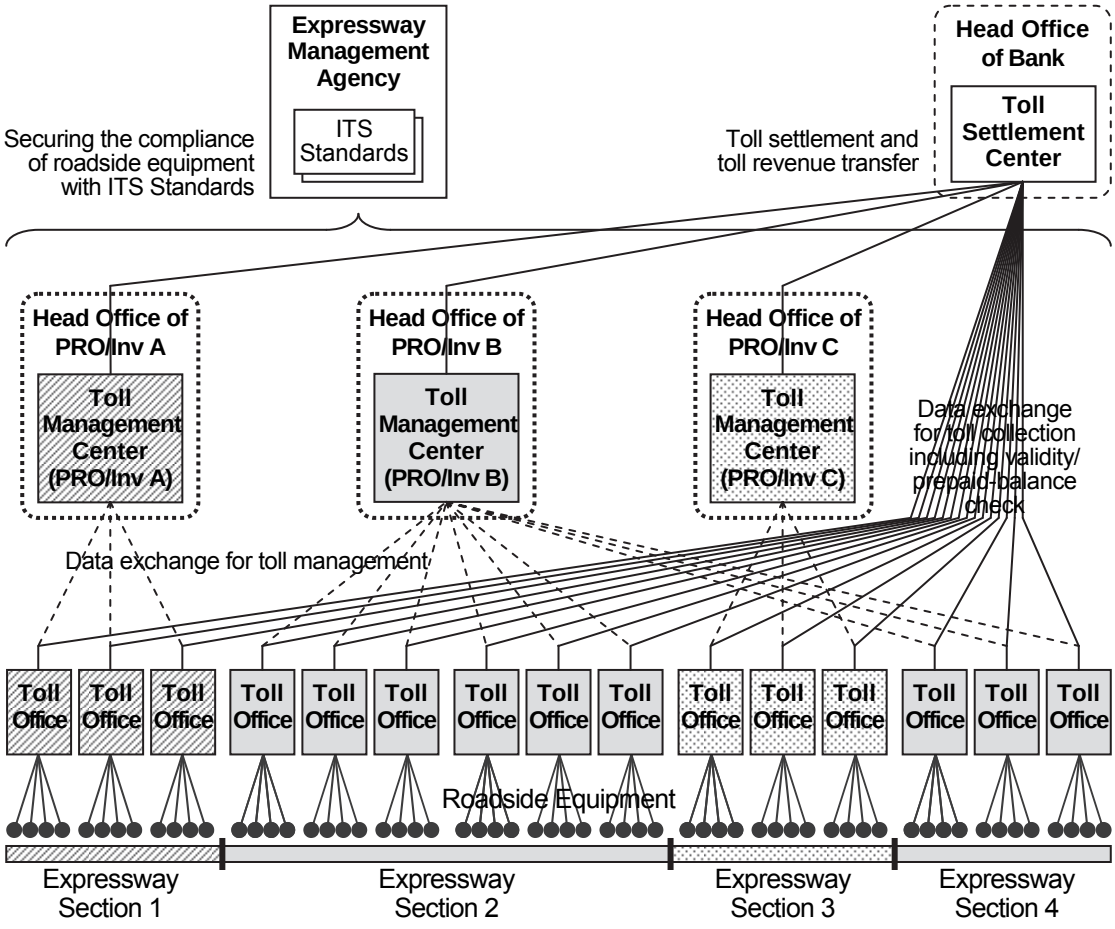
3.5.1 Key Framework

The framework for toll management in the following figure, which includes many different Public Road Owners and Investors (PRO/Invs) and a bank, is to be defined as a premise for discussion in the Study. The processes of toll collection including validity/prepaid-balance check are to be executed through the data exchange between a toll office and a bank, and the processes of cash storage and toll settlement are to be transferred to a bank. The application software is to be operated/managed by toll offices and the bank respectively and the regulation on roadside equipment are to be executed by the Expressway Management Agency in compliance with the ITS Standards.

(1) Roles of Expressway Management Agency

- Regulation on hardware/software in compliance with the ITS Standards
- Integrated management on the data from toll collection/management, traffic information/ control and heavy truck control (including overloading regulation)
- Check of the validity of toll revenue in comparison with the data of traffic.

Figure 3.12 Framework for Toll Management



Note: ▌: Barrier tollgates between the expressway sections of different road operators

Source: The Study Team

(2) Roles of Public Road Owner or Investor (PRO/Inv, of Each Section)

- Funding/maintenance of road structure/facilities of an expressway section other than ITS
- Funding of facilities of ITS of an expressway section
- Toll management of an expressway section
- Charge for toll revenue to the bank.

(3) Roles of Road Operator (of Each Section)

- Operation/maintenance of equipment including software for ITS
- Toll collection works of an expressway section.

(4) Roles of Bank

- Validity/prepaid-balance check for toll collection
- Toll settlement and toll revenue transfer to PRO/Inv.

3.5.2 Framework for Toll Settlement

Issue/top-up service for IC-cards is provided by a single bank in the 1st stage and by several different banks in later stages. These frameworks for toll settlement are based on utilization of a single kind of IC-card shared by different Public Road Owners and Investors (PRO/Invs). The roles are to be shared as follows:

(1) Roles of Public Road Owner or Investor (PRO/Inv, of Each Section)

- Toll management of an expressway section

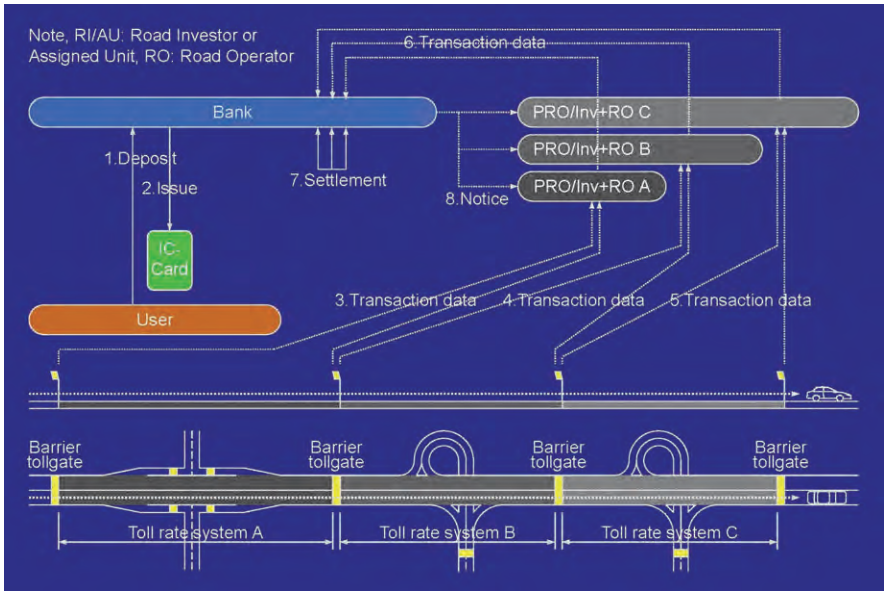
(2) Roles of Road Operator (of Each Section)

- Toll collection works of an expressway section

(3) Roles of Bank

- IC-card issue/ management and prepayment service
- Validity/prepaid-balance check for toll collection
- Toll settlement and toll revenue transfer to PRO/Inv.

Figure 3.13 Framework for Toll Settlement



Source: The Study Team

3.5.3 Framework for IC-Card Issuance/Operation

The framework below needs to be established for IC-card issuance/operation in both use of Touch&Go and ETC. Issue/top-up service is provided by a single bank in the 1st stage and by several banks in later stages. In this framework, the roles are to be shared as follows:

(1) Roles of Public Road Owner or Investor (PRO/Inv, of Each Section)

- Toll management of an expressway section
- Charge for toll revenue to the bank.

(2) Roles of Road Operator (of Each Section)

- Toll collection works of an expressway section.

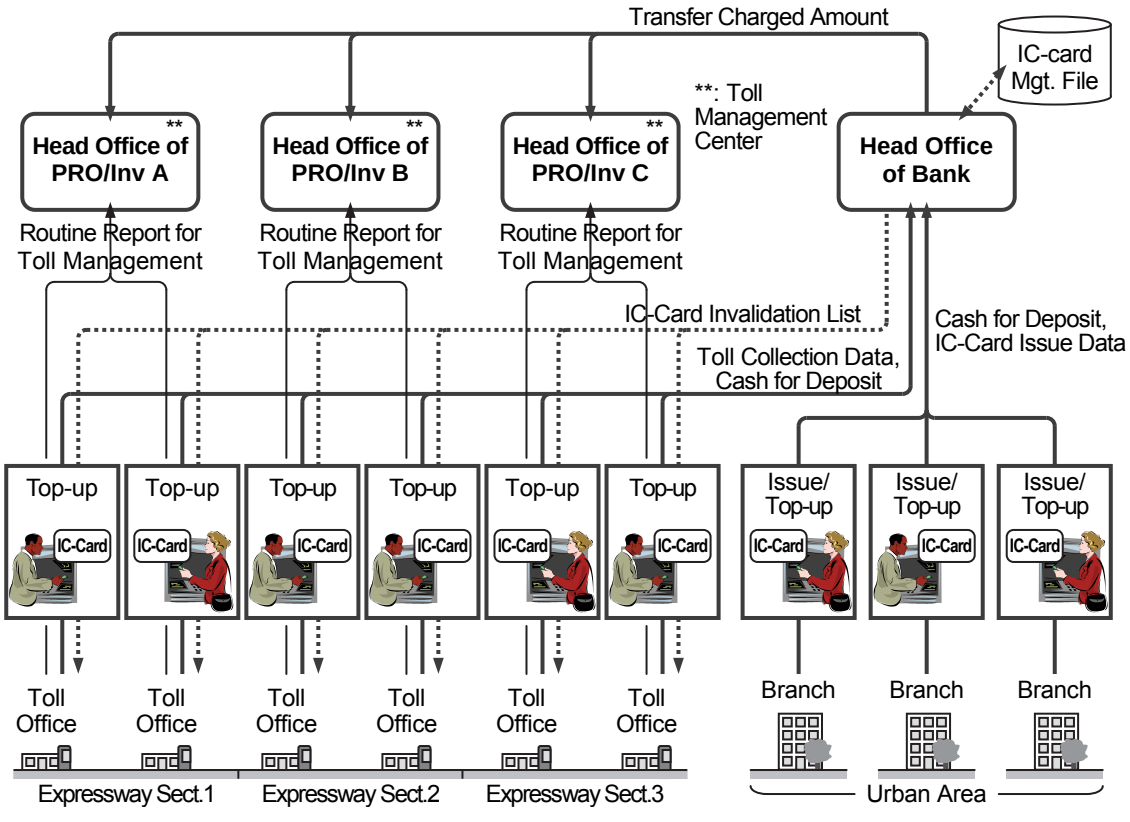
(3) Roles of Bank

- IC-card issue/ management and prepayment service
- Reception of claim for invalidation of an IC-card from a user
- Generation/distribution of IC-card invalidation list and assistance for toll enforcement
- Validity/prepaid-balance check for toll collection
- Toll settlement and toll revenue transfer to PRO/Inv.

Required Condition:

- Authorization of the bank for issuing/operating IC-card for ETC and Touch&Go.

Figure 3.14 Framework for IC-Card Issuance/Operation



Source: The Study Team

3.5.4 Framework for OBU Registration/Management

The framework below needs to be prepared for OBU registration/management, in which an OBU management center is operated by a unified organization for many different Public Road Owners, Investors (PRO/Invs) and banks, because several banks will make a toll settlement by ETC in later stage. The roles are to be shared as follows:

(1) Roles of Expressway Management Agency

- Regulation on hardware/software in compliance with the ITS Standards
- Transfer of transaction data/status for assisting toll enforcement.

(2) Roles of Public Road Owner or Investor (PRO/Inv, of Each Section)

- Toll management of an expressway section.

(3) Roles of Road Operator (of Each Section)

- Toll collection works of an expressway section.

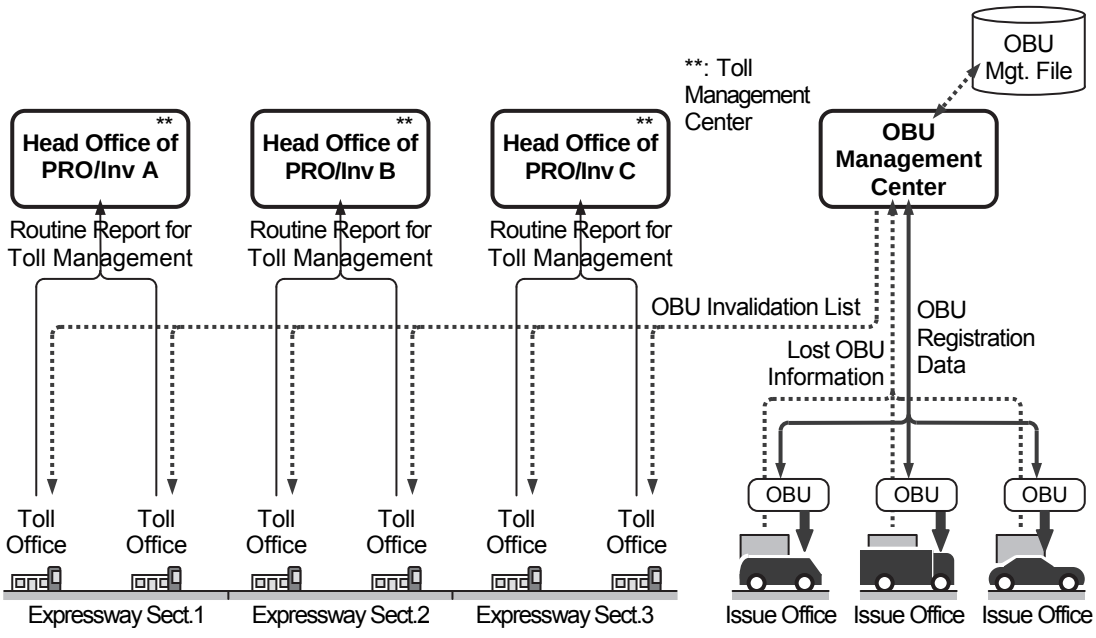
(4) Roles of OBU Management Organization

- OBU registration/management service
- Generation/distribution of OBU invalidation list and assistance for toll enforcement.

Required Condition:

- Setting up of the OBU Management Center (which can be installed in a bank or other organization such as Vietnam Register).

Figure 3.15 Framework for OBU Registration/Management



Source: The Study Team

3.5.5 Framework for Toll Enforcement

The framework for toll enforcement and invalidation is shown in the figure below. In the framework, invalidation of IC-card or OBU is to be claimed by the user and the enforcement process is to be performed in cooperation between the Public Road Owner or Investor (PRO/Inv) and the detective police through the bank and OBU management center. The roles are to be shared as follows:

(1) Roles of Expressway Management Agency

- Regulation on hardware/software in compliance with the ITS Standards

(2) Roles of Public Road Owner or Investor (PRO/Inv, of Each Section)

- Toll management of an expressway section

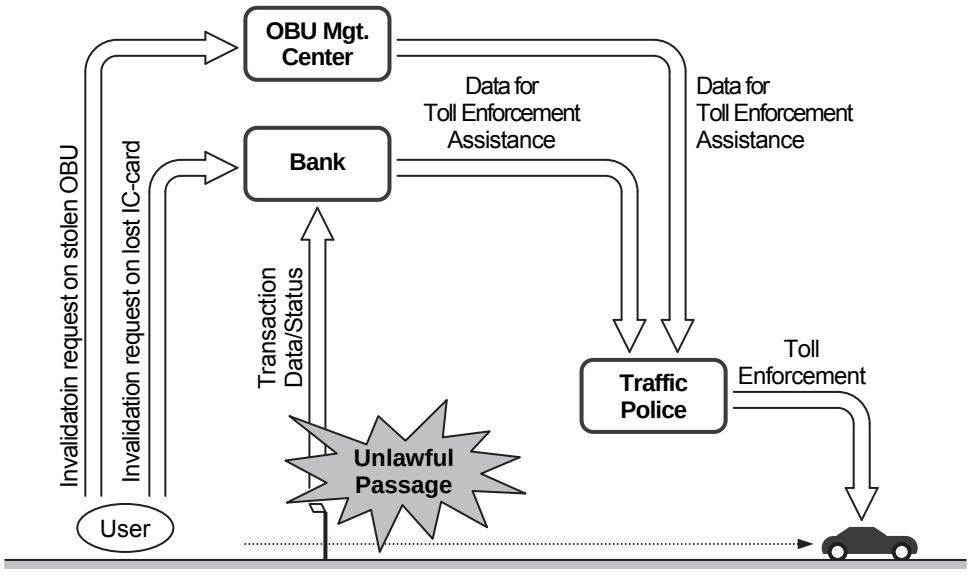
(3) Roles of Bank

- IC-card issue/top-up/management service
- Reception of claim for invalidation of an IC-card from a user
- Generation/distribution of IC-card invalidation list and assistance for toll enforcement

(4) Roles of OBU Management Organization

- OBU registration/management service
- Reception of claim for invalidation of an OBU from a user
- Generation/distribution of OBU invalidation list and assistance for toll enforcement

Figure 3.16 Framework for Toll Enforcement (including Invalidation)

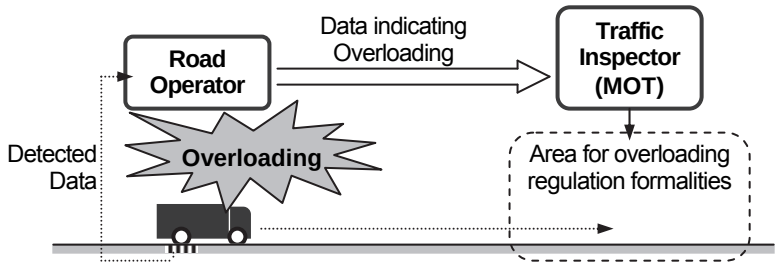


Source: The Study Team

3.6 Framework for Overloading Regulation

The procedure for overloading regulation is shown in the figure below. The role of road operator is to handover the inspector the information on the overloaded vehicle and the data from vehicle weighing system which indicates the fact of overloading.

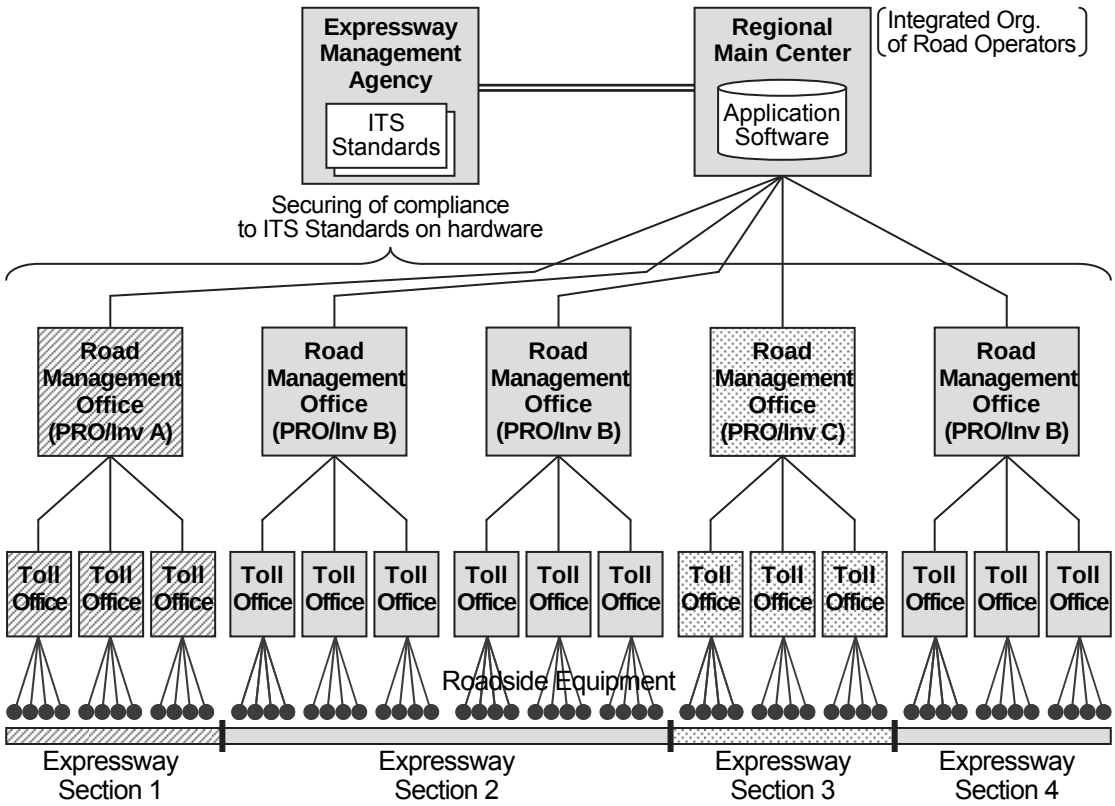
Figure 3.17 Procedure for Overloading Regulation



Source: ITS Standards & Operation Plan Study Team

The framework for overloading regulation shown in the figure below includes many different Public Road Owners and Investors (PRO/Invs), who own the expressway section and the vehicle weighing system, and the Regional Main Center. The Standards on hardware is to be managed by the Expressway Management Agency and the application software is to be managed/distributed by the Regional Main Center.

Figure 3.18 Framework for Overloading Regulation



Note: ▌: Barrier tollgates between the expressway sections of different road operators

Source: The Study Team

(1) Roles of Expressway Management Agency

- Regulation on hardware/software in compliance with the ITS Standards

(2) Roles of Public Road Owner or Investor (PRO/Inv, of Each Section)

- Funding/maintenance of road structure/facilities of an expressway section other than ITS
- Funding of facilities of ITS of an expressway section

(3) Roles of Road Operator (of Each Section)

- Operation/maintenance of hardware/software of ITS
- Overloading regulation works of an expressway section

Required Condition:

- Legal basis for rejecting overloaded heavy trucks from the expressway by measuring its axle loads
- Legal basis for controlling unlawful drivers who ignore penalty against overloading or payment of toll.

3.7 Framework for Integrated Data Management

The framework shown below needs to be prepared for integrated data management. Traffic data, axle load data and toll revenue data are to be acquired and stored at the same place, and to be utilized for developing plans of inspection and budget for road maintenance and checking the validity of required toll revenue. The roles are to be shared as follows:

(1) Roles of Expressway Management Agency

- Regulation on hardware/software in compliance with the ITS Standards
- Integrated management on the data from toll collection/management, traffic information/ control and heavy truck control (including overloading regulation)
- Development of inspection/budget plan of expressway improvement/maintenance
- Check of the validity of toll revenue in comparison with the data of traffic
- Evaluation of road operator's achievement in the expressway operation.

(2) Roles of Public Road Owner or Investor (PRO/Inv, of Each Section)

- Ownership/funding of road structure/facilities other than ITS
- Ownership/funding of facilities of ITS
- Operation/maintenance of hardware/software of ITS (in the case of service contract).
- Toll collection/management of an expressway section.

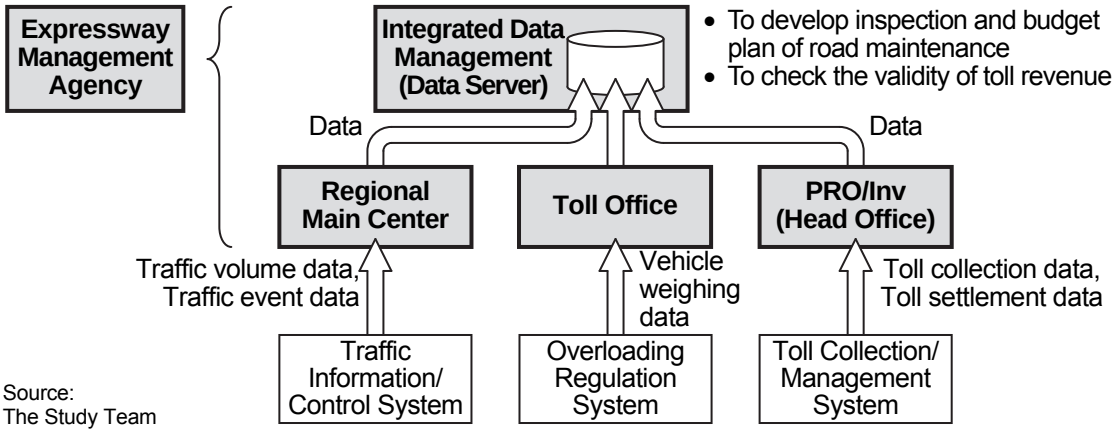
(3) Roles of Road Operator (of Each Section)

- Funding of facilities of ITS (in the case of concession contract)
- Operation/maintenance of hardware/software of ITS
- Traffic information/control of an expressway section
- Toll collection works of an expressway section
- Overloading regulation works of an expressway section.

Required Condition:

- Integrated data management of ITS under the Expressway Management Agency.

Figure 3.19 Framework for Integrated Data Management



Source:
The Study Team

3.8 Framework for Communication Network Management

3.8.1 Key Framework

It is recommended for the Public Road Owners, Investors (PRO/Invs) and the road operators to outsource the trunk communication network management to a telecom service company, because telecom service companies have higher skills. Introduction of trunk communication system/equipment also is to be outsourced to the telecom service companies in the future, as proposed in the Decision No.3569/VPCP-KTN VNPT, because they can select appropriate system, which will not be the hindrance of the operation and maintenance.

(1) Roles of Public Road Owner or Investor (PRO/Inv, of Each Section)

- Ownership/funding of facilities of ITS
- Operation/maintenance of hardware/software of ITS (in the case of service contract).

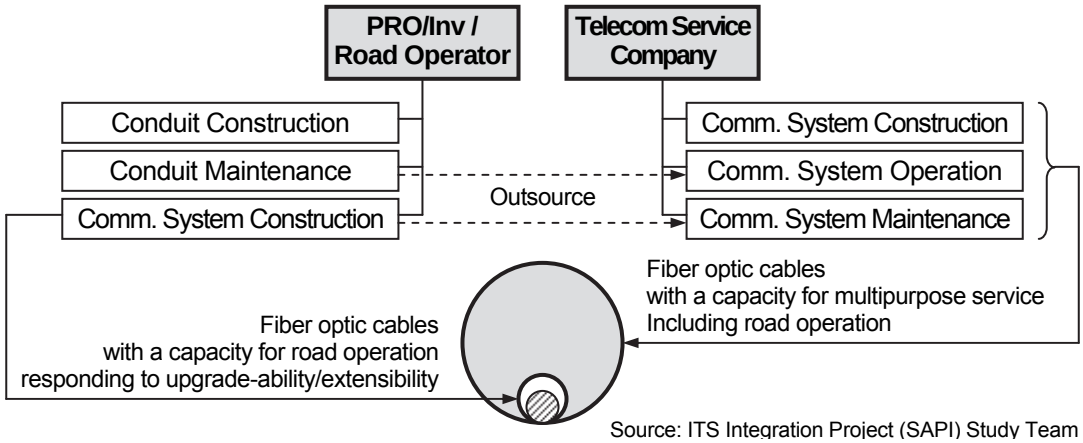
(2) Roles of Road Operator (of Each Section)

- Funding of facilities of ITS (in the case of concession contract)
- Operation/maintenance of hardware/software of ITS.

(3) Roles of Telecom Service Company

- Funding/maintenance of facilities of trunk communication system of ITS
- Operation of trunk communication system of ITS.

Figure 3.20 Framework for Communication Network Management



Source: ITS Integration Project (SAPI) Study Team

3.8.2 Framework for Radio Frequency Allocation

Upon the utilization of radio frequency, there is a band necessary to obtain the license. The necessity of the license should be checked to Radio Frequency Directorate, if the frequency to be used is required to be licensed, the road operator in road management office should submit the application to Radio Frequency Directorate, and before installing the radio transmitter, the license shall be obtained. The roles are to be shared as follows:

(1) Roles of Radio Frequency Directorate

- Issuance of the license for utilization of radio frequency

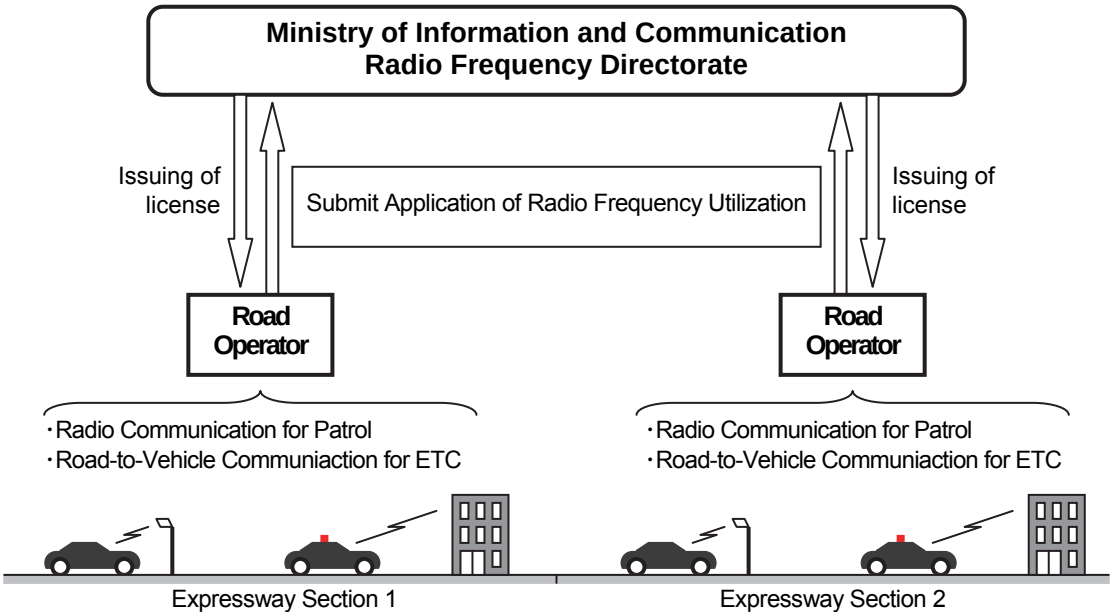
(2) Roles of Public Road Owner or Investor (PRO/Inv, of Each Section)

- Submission of the application for utilization of radio frequency

(3) Roles of Road Operator (of Each Section)

- Operation of mobile radio communication for patrol and road-to-vehicle communication for ETC

Figure 3.21 Framework for Radio Frequency Allocation



Source: ITS Integration Project (SAPI) Study Team

3.9 Framework for System Maintenance

Maintenance of structures/facilities in the Regional Main Center, road management offices, toll offices and at roadside are to be shared by MOT, the Public Road Owners, the Investors (PRO/Invs) and the road operators. In addition, facilities for communication system, IC-cards and OBUs are to be maintained respectively by the telecom service company, the bank and the OBU management center.

(1) Roles of Expressway Management Agency

- Ownership/funding of the Regional Main Center
- Operation/maintenance of hardware/software of ITS
- Regulation on hardware/software in compliance with the ITS Standards.

(2) Roles of Public Road Owner or Investor (PRO/Inv, of Each Section)

- Ownership/funding of facilities of ITS
- Operation/maintenance of hardware/software of ITS (in the case of service contract).

(3) Roles of Road Operator (of Each Section)

- Funding of facilities of ITS (in the case of concession contract)
- Operation/maintenance of hardware/software of ITS.

(4) Roles of Telecom Service Company (in the Future)

- Funding/maintenance of facilities of trunk communication system of ITS
- Operation of trunk communication system of ITS.

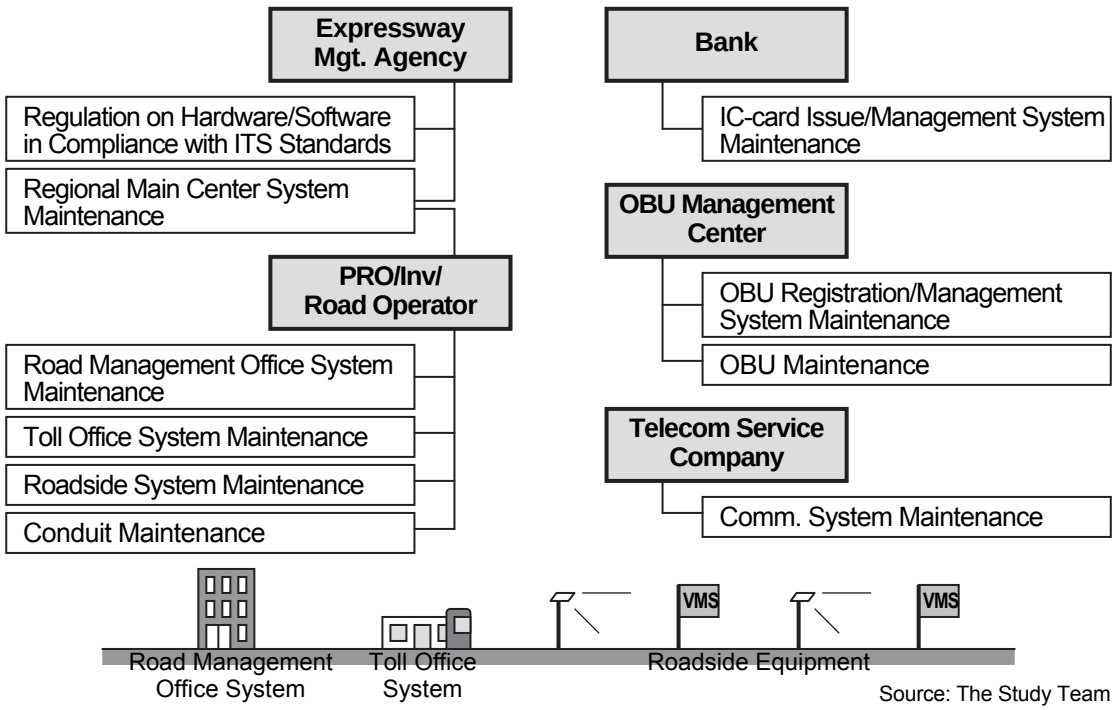
(5) Roles of Bank

- IC-card issue/management and prepayment service

(6) Roles of OBU Management Center

- OBU registration/management service.

Figure 3.22 Framework for System Maintenance



Source: The Study Team

3.10 Required Conditions on Frameworks for ITS

It is clarified that the frameworks for ITS are to be built based on the required conditions below.

For Traffic Information/Control:

- Integration of the functions of expressway traffic control at road management offices under the Regional Main Center
- Decision and implementation of traffic restriction/closure under the responsible government agency
- Setting up of the special telephone number (without area code) for the emergency call at expressway
- Installation of a team to perform the functions of road operator, police and ambulance service in each road management office.

For Nonstop Toll Collection:

- Authorization of the bank for issuing/operating IC-card for ETC and Touch&Go
- Setting up of the OBU Management Center (which can be in the Vietnam Register).

For Heavy Truck Control and others:

- Legal basis for rejecting overloaded heavy trucks from the expressway by measuring its axle loads
- Legal basis for controlling unlawful drivers who ignore penalty against overloading or payment of toll
- Integrated data management of ITS under the Expressway Management Agency.

4. System Architecture

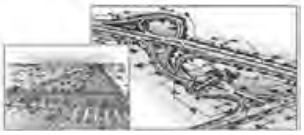
4.1 General

The system architecture required for achieving the three Priority ITS User Services and the location of its elementary equipment components are shown in this Chapter.

4.2 Required ITS User Services

The three Priority ITS User Services below and the Road Map comprises three stages have been shown in the ITS Master Plan for the expressways in Vietnam.

Table 4.1 Priority ITS User Services

ITS User Services	Service Descriptions
Traffic Information/Control 	This service provides accurate surveillance of traffic conditions on expressway and adjacent arterial roads. This service assists prompt action of the road operator and the emergency vehicles by notifying occurrence of traffic accidents, broken-down vehicles and other obstacles. This service allows drivers en route and in advance to avoid the influence of the incidents by providing accurately updated information. This service also allows appropriate interchange/route selection by providing drivers en route with information; such as crowdedness and travel-time. This service makes it possible to measure actual traffic volume continuously for developing rational road construction/improvement plan. Implementation Packages: • Incident Information • Traffic Congestion Information • Weather Information • Traffic Control Assistance • Center-to-center Data Exchange.
Nonstop Toll Collection 	This service enables toll collection without stopping vehicles: ETC (Electronic Toll Collection). This service relieves bottlenecks at the tollgates and allows smooth incoming and outgoing at the interchanges. This service reduces the number of tollbooths and solves the problem of land acquisition for the tollgates in suburban areas where traffic congestion will become an issue in near future. This service realizes simple vehicle inspection at the border crossings, and provides road or vehicle operators with the time of vehicle passage at the tollgates. Computerized toll management can vastly reduce uncollected toll revenue due to the failure in counting/classifying vehicles and can realize proper sharing of the toll revenue among different road operators. Implementation Packages: • Toll Collection • Center-to-center Data Exchange.
Heavy Truck Control 	This service eliminates overloading of heavy trucks by automatic execution of vehicle weighing at interchanges. It restrains damage to the road structure and extends its durable lifetime. This service restrains congestion caused by heavy trucks and allows freight trans-port to improve safety by eliminating overloading. This service allows prompt action of the road operator at the occurrence of serious accidents caused by heavy trucks and hazardous-material trucks and appropriate vehicle operation by keeping track of the trucks on the expressway network. Implementation Packages: • Vehicle Weighing • Center-to-center Data Exchange.

A gradual approach is proposed for the road map of ITS implementation in the ITS Master Plan. In the road map, it is proposed that ITS is to be implemented focusing on the three Priority ITS User Services in the first stage and to be extended by package in later stages as below.

Figure 4.1 Road Map of ITS Implementation in Vietnam

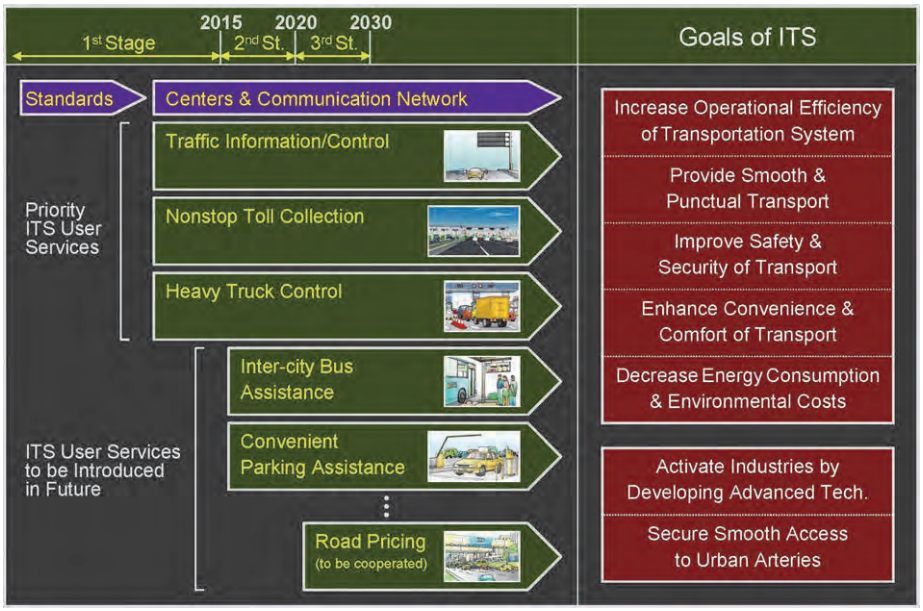


Figure 4.2 ITS Implementation by Package

	1st Stage 2015 — 2nd Stage 2020 — 3rd Stage 2030

Traffic Information/ Control	• Incident information (giving importance to notification assistance)
	• Traffic congestion information (related to incidents)
	• Weather information
	• Traffic control assistance (responding to occurrences of incidents)
	• Center-to-center data exchange for traffic information/control
	  • Traffic congestion information
	  • Travel-time information
	  • Traffic control assistance
	  • Incident information by monitoring continuously along the roads

Non-stop Toll Collection	• Non-stop toll collection (at toll island) • Center-to-center data exchange for non-stop toll collection • Non-stop toll collection on free-flow at ETC exclusive interchange

Heavy Truck Control	• Vehicle weighing (for overloading regulation)
	• Center-to-center data exchange for overloading regulation
	  • Heavy/hazmat truck tracking
	  • Center-to-center data exchange for truck tracking

Inter-city Bus Assistance	• Bus tracking information provision • Center-to-center data exchange for bus tracking

Convenient Parking Assistance	• Parking information provision
	• Center-to-center data exchange for convenient parking assistance
	  • Parking fee collection at highway-oasis
	  • Integrated fee collection for park&bus-ride
	  • Center-to-center data exchange for park &bus-ride fee collection

Road Pricing	• Cooperation with road pricing in urban areas

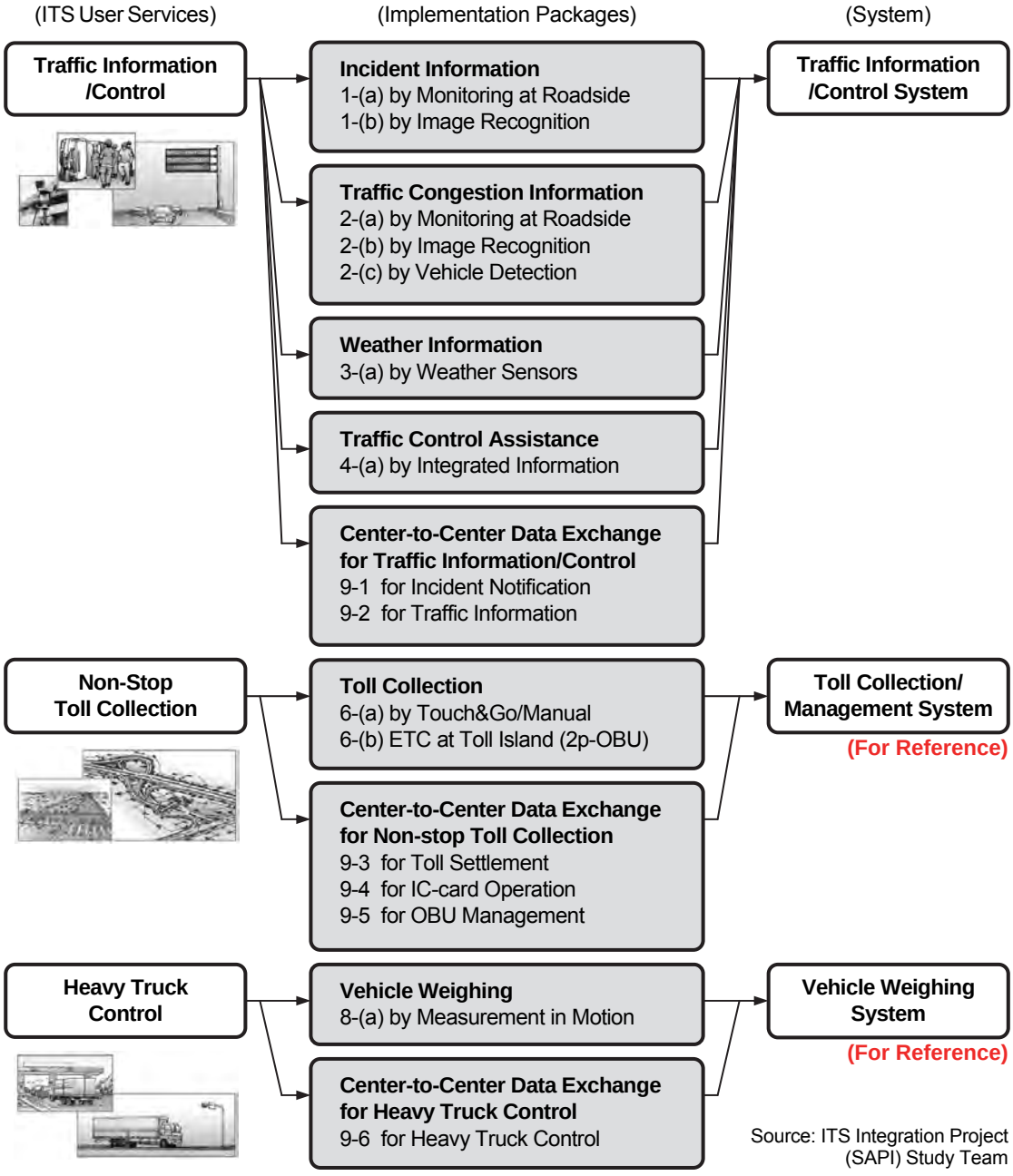
Note, Hazmat truck: hazardous-material truck.

Source: ITS Integration Project (SAPI) Study Team

4.3 System Architecture for Implementation Packages

The system to be implemented for achieving the three Priority ITS User Services can be divided into the implementation packages shown below.

Figure 4.3 Implementation Packages for Priority ITS User Services



Source: ITS Integration Project (SAPI) Study Team

The system architecture for actualizing each implementation package are to be composed of subsystems as shown in the Part 2 of Appendix-2.

4.4 Functional Packages

The system architecture of the respective Implementation Packages of ITS are composed of Functional Packages. Based on the Functional Packages, the roles of organizations for implementing/operating/maintaining ITS are to be discussed, the quantities required for the Project are to be calculated and the costs are to be estimated in the Study. Correspondences between the Functional Packages and the Implementation Packages aforementioned are shown in the table below. Details of the Functional Packages are described in the Part 2 of Appendix-2.

Table 4.2 Functional Packages corresponded to Implementation Packages

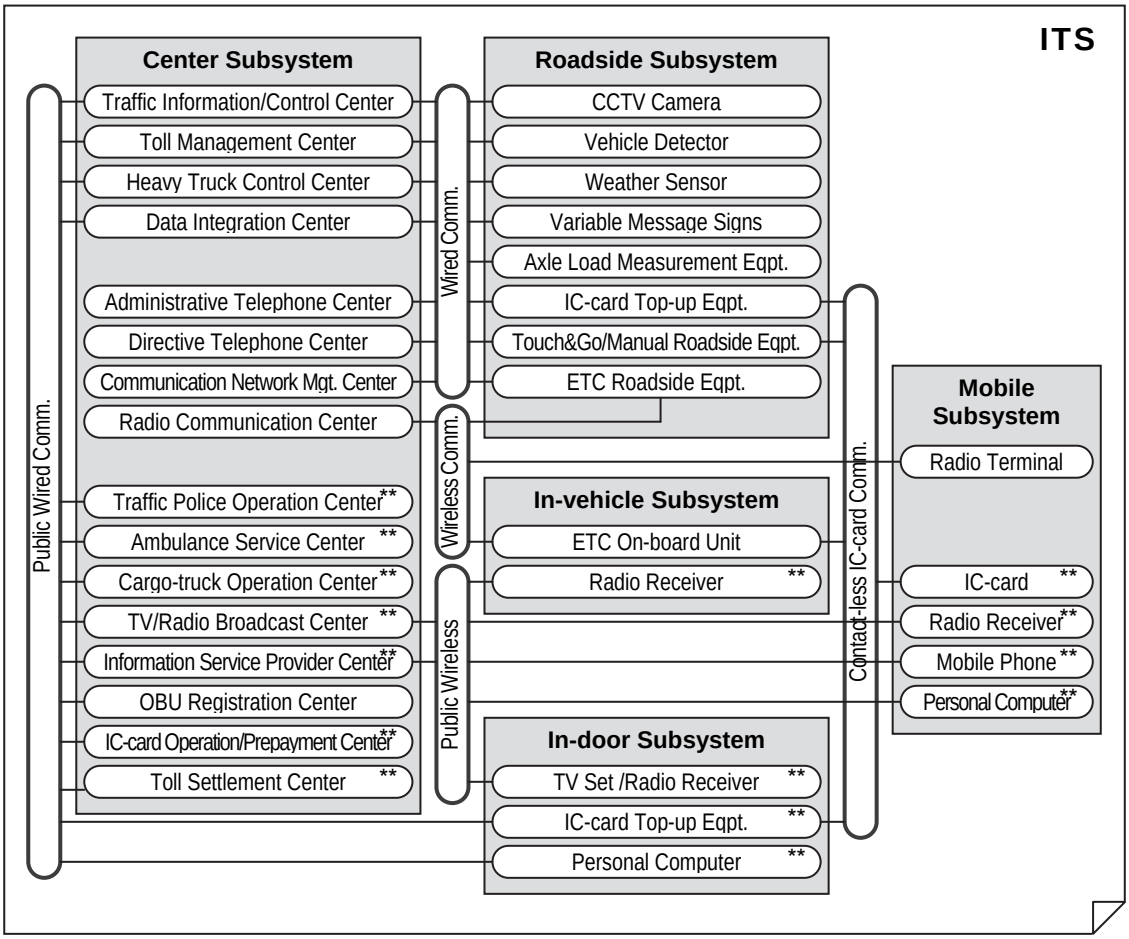
User Services / Implementation Packages	Functional Packages	Incident Information	raffic Congestion Information	Weather Information	Traffic Control Assistance	C-to-C Data Exchange for Traffic Information/Control	Toll Collection	C-to-C Data Exchange for Toll Collection/Management	Vehicle Weighing	C-to-C Data Exchange for Heavy Truck Control
1. Traffic Information/ Control	(1) Voice Communication	XX			XX	XX				
	(2) CCTV Monitoring	XX	XX							
	(3) Event Detection (by Image)		XX							
	(4) Vehicle Detection		XX							
	(5) Traffic Analysis		XX							
	(6) Weather Monitoring			XX						
	(7) Traffic Event Data Management	XX	XX	XX	XX					
	(8) Traffic Supervision	XX	XX	XX	XX					
	(9) VMS Indication	XX	XX	XX	XX					
	(10) Mobile Radio Communication				XX					
	(11) Traffic Information					XX				
	(12) Integrated Data Management					XX		XX		XX
2. Toll Collection/ Management	(13) Tollgate Lane Monitoring						XX			
	(14) Vehicle/Class Identification						XX			
	(15) Lane Control						XX			
	(16) Road-to-Vehicle Communication						XX			
	(17) IC-card Recording						XX			
	(18) Toll Data Management						XX	XX		
	(19) OBU Management							XX		
3. Vehicle Weighing	(20) Axle Load Measurement								XX	
	(21) Measurement Lane Monitoring								XX	

Source: The Study Team

4.5 Total System Architecture and Operating Organizations

The total system architecture for the priority ITS user services can be illustrated as shown below in reference to the ITS Master Plan.

Figure 4.4 Total System Architecture for Priority ITS User Services



Note, ** : Operated by the entity other than the road operators.

Source: ITS Integration Project (SAPI) Study Team

The centers above are to be owned and operated respectively by the following organizations shown in the operation frameworks aforementioned:

- Road operator
- Road owner
- Expressway Management Agency (VEA)
- Traffic police agency
- Ambulance service operator
- Cargo-truck company
- TV/Radio broadcast company
- Information service provider
- OBU registration agency
- Bank.

The logical center subsystems in the total system architecture are to be operated by the

respective organizations as shown in the table below.

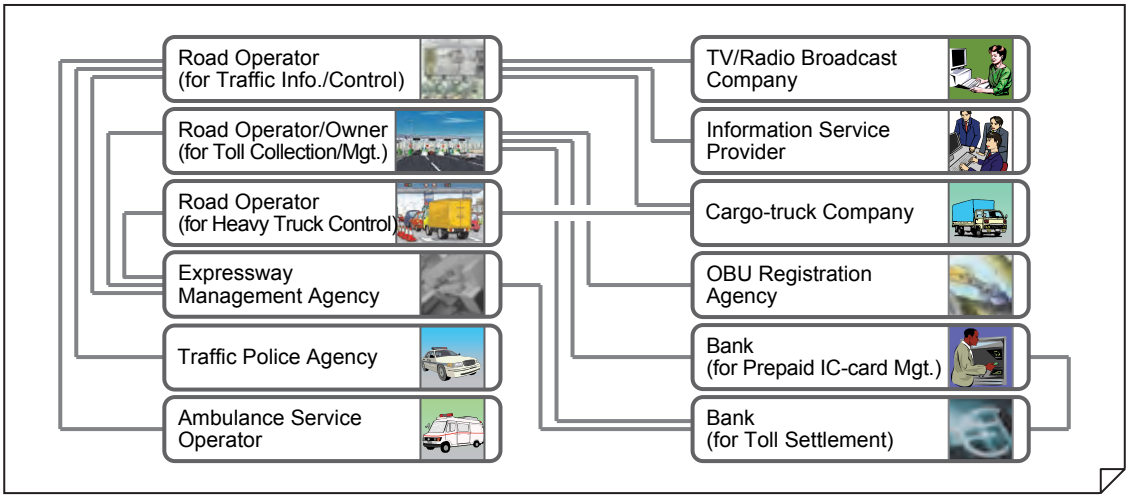
Table 4.3 Operating Organizations of Center Subsystems

Operating Organizations / Center Subsystems	Road Operator (at Regional Main Center)	Road Operator (at Road Mgt. Office)	Road Operator (at Toll Office)	Road Owner (at Head Office)	Expressway ManagementAgency	Traffic Police Agency	Ambulance Service Operator	Cargo-truck Company	TV/Radio Broadcast Company	Information Service Provider	OBU Registration Agency	Bank
Traffic Information/Control Center	XX	XX										
Toll Management Center			XX	XX								
Heavy Truck Control Center			XX									
Data Integration Center					XX							
Administrative Telephone Center	XX	XX										
Directive Telephone Center	XX											
Communication Network Mgt. Center	XX	XX										
Radio Communication Center		XX										
Traffic Police Operation Center						XX						
Ambulance Service Center							XX					
Cargo-truck Operation Center								XX				
TV/Radio Broadcast Center									XX			
Information Service Provider Center										XX		
OBU Registration Center											XX	
IC-card Management Center												XX
Toll Settlement Center												XX

Note: XX : Necessity of the function.

Center-to-Center relations among the operating organizations can be extracted as below.

Figure 4.5 Center-to-Center Relation among Operating Organizations



5. Role Sharing for System Operation

5.1 General

In this Chapter, the roles of the following organizations are to be clarified in the form of matrix table, discussing the frameworks responding to each Functional Package:

- Expressway Management Agency
- Public Road Owner or Investor
- Road Operator
- Telecommunication service company
- Other organizations (such as OBU management organization and bank).

These organizations shall share the roles and cooperate for operating and maintaining each Functional Package.

In Vietnam, as mentioned in Chapter 4 in the Main Report of the Study, the major part of operation/maintenance of the road is to be carried out under one of the following schemes:

- Service contract
- Concession contract.

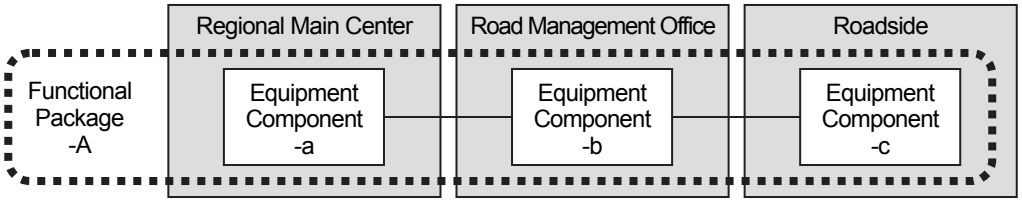
Additionally, the operation/maintenance of communication system is to be carried out under the scheme of lease contract. Based on these schemes, the matrix tables in this Chapter are to be illustrated using the roles below:

- Ownership
- All capital investments (including working capital funds and rehabilitation costs)
- Working capital funds and rehabilitation costs
- Operation/maintenance services
- Tariff setting and toll collection
- Establishing performance standards and monitoring conformity.

5.2 Location of Equipment Components

ITS consists of many Functional Packages. Each Functional Package consists of several equipment components which are installed separately in different locations as illustrated by the figure below. However, the components in the centers and the at roadside are operated respectively by the different organizations. For discussing the system operation, accordingly, the roles of respective organizations are to be detailed responding to the Functional packages and the installed places such as centers and offices.

Figure 5.1 Functional Package Consists of Equipment Components in Different Locations



Source: ITS Integration Project (SAPI) Study Team

The equipment components defined in the system architecture are to be installed respectively in the centers, offices and other places, based on the Functional Packages, as shown in the figure and table below.

Table 5.1 Location of Equipment Components based on Functional Packages

Functional Packages		Center Subsystem						Roadside Subsystem	On-board Subsystem	Mobile Subsystem	In-door Subsystem
		Regional Main Center	Data Integration Center	Road Management Office	Toll Office	Road Owner's Head Office	OBU Registration Office				
1	Voice Communication	XX		XX	XX			XX			
2	CCTV Monitoring	XX		XX				XX			
3	Event Detection (by Image)							XX			
4	Vehicle Detection							XX			
5	Traffic Analysis	XX									
6	Weather Monitoring	XX						XX			
7	Traffic Event Management	XX		XX							
8	Traffic Supervision	XX									
9	VMS Indication	XX						XX			
10	Mobile Radio Communication			XX				XX		XX	
11	Traffic Information	XX									XX
12	Integrated Data Management	XX	XX		XX	XX					
13	Tollgate Lane Monitoring				XX			XX			
14	Vehicle/Class Identification							XX			
15	Lane Control							XX			
16	Road-to-Vehicle Communication							XX	XX		
17	IC-card Recording							XX		XX	XX
18	Toll Data Management				XX	XX					
19	OBU Management			XX			XX				XX
20	Axle Load Measurement							XX			
21	Measurement Lane Monitoring				XX						
Communication System		XX	XX	XX	XX			XX			
Communication Ducts		XX		XX	XX			XX			
Base Structures		XX		XX	XX			XX			
Electric Power Supply		XX	XX	XX	XX			XX			

Source: The Study Team

5.3 Roles of Expressway Management Agency

The Expressway Management Agency is set up as the expressway management organization in MOT in 1st April 2011, is transferred to DRVN in 26th April 2012 and will be change into the Expressway Management Agency.

From the discussion on frameworks foregoing, roles of the Expressway Management Agency are to be sort out as shown below.

Table 5.2 Roles of Expressway Management Agency

Items		Center Subsystem						Roadside Subsystem	On-board Subsystem	Mobile Subsystem	In-door Subsystem
		Regional Main Center	Data Integration Center	Road Management Office	Toll Office	Road Owner's Head Office	OBU Registration Office				
Functional Packages											
1	Voice Communication	XX/S		S	S			S			
2	CCTV Monitoring	XX/S		S				S			
3	Event Detection (by Image)	XX/S						S			
4	Vehicle Detection	XX/S						S			
5	Traffic Analysis	XX/S									
6	Weather Monitoring	XX/S						S			
7	Traffic Event Data Management	XX/S		S							
8	Traffic Supervision	XX/S									
9	VMS Indication	XX/S						S			
10	Mobile Radio Communication			S				S		S	
11	Traffic Information	XX/S									
12	Integrated Data Management	XX/S	XX/S		S	S					
13	Tollgate Lane Monitoring				S			S			
14	Vehicle/Class Identification							S			
15	Lane Control							S			
16	Road-to-Vehicle Communication							S	S		
17	IC-card Recording							S		S	
18	Toll Data Management				S	S					
19	OBU Management			S			S				S
20	Axle Load Measurement							S			
21	Measurement Lane Monitoring				S						
Communication System		XX/S	XX/S								
Communication Ducts		XX/S									
Base Structures		XX/S									
Electric Power Supply		XX/S	XX/S								

Note, XX: Ownership, all capital investments and operation/maintenance services, S: Establishing performance standards and monitoring conformity.

Source: The Study Team

5.4 Roles of Public Road Owner or Investor (for Service Contract)

From the discussion on frameworks foregoing, roles of the Public Road Owner or Investor are sorted out as shown below for the service contract. Where, the Public Road Owners or Investor has been assigned respectively to the following sections in the Project Scope:

- VEC: Cau Gie–Ninh Binh
- HPC: Ring Road 3, Lang–Hoa Lac and Noi Bai–Ca Lo Bridge
- Bac Ninh Province: Ca Lo Bridge–Bac Ninh.

Table 5.3 Roles of Public Road Owner or Investor

Items		Center Subsystem						Roadside Subsystem	On-board Subsystem	Mobile Subsystem	In-door Subsystem
		Regional Main Center	Data Integration Center	Road Management Office	Toll Office	Road Owner's Head Office	OBU Registration Office				
Functional Packages											
1	Voice Communication			XX	XX			XX			
2	CCTV Monitoring			XX				XX			
3	Event Detection (by Image)			XX				XX			
4	Vehicle Detection			XX				XX			
5	Traffic Analysis										
6	Weather Monitoring							XX			
7	Traffic Event Data Management			XX							
8	Traffic Supervision										
9	VMS Indication							XX			
10	Mobile Radio Communication			XX					XX	XX	
11	Traffic Information										
12	Integrated Data Management				XX	XX					
13	Tollgate Lane Monitoring				XX			XX			
14	Vehicle/Class Identification							XX			
15	Lane Control							XX			
16	Road-to-Vehicle Communication							XX			
17	IC-card Recording							XX			
18	Toll Data Management				XX	XX					
19	OBU Management			XX							
20	Axle Load Measurement							XX			
21	Measurement Lane Monitoring				XX						
Communication System				XX	XX			XX			
Communication Ducts				XX	XX			XX			
Base Structures				XX	XX			XX			
Electric Power Supply				XX	XX			XX			

Note, XX: Owner ship, all capital investments, operation/maintenance services, tariff setting and toll collection.

Source: The Study Team

5.5 Roles of Public Road Owner (for Concession Contract)

From the discussion on frameworks foregoing, roles of the Public Road Owner or Investor are sorted out as shown below for the concession contract. Where, the Public Road Owners or Investor has been assigned respectively to the following sections in the Project Scope:

- DRVN: Phap Van–Cau Gie and Ha Noi–Bac Giang

Table 5.4 Roles of Public Road Owner or Investor

Items		Center Subsystem						Roadside Subsystem	On-board Subsystem	Mobile Subsystem	In-door Subsystem
		Regional Main Center	Data Integration Center	Road Management Office	Toll Office	Road Owner's Head Office	OBU Registration Office				
Functional Packages											
1	Voice Communication			XX	XX			XX			
2	CCTV Monitoring			XX				XX			
3	Event Detection (by Image)			XX				XX			
4	Vehicle Detection			XX				XX			
5	Traffic Analysis										
6	Weather Monitoring							XX			
7	Traffic Event Data Management			XX							
8	Traffic Supervision										
9	VMS Indication							XX			
10	Mobile Radio Communication			XX					XX	XX	
11	Traffic Information										
12	Integrated Data Management				XX	XX					
13	Tollgate Lane Monitoring				XX			XX			
14	Vehicle/Class Identification							XX			
15	Lane Control							XX			
16	Road-to-Vehicle Communication							XX			
17	IC-card Recording							XX			
18	Toll Data Management				XX	XX					
19	OBU Management			XX							
20	Axle Load Measurement							XX			
21	Measurement Lane Monitoring				XX						
Communication System				XX	XX			XX			
Communication Ducts				XX	XX			XX			
Base Structures				XX	XX			XX			
Electric Power Supply				XX	XX			XX			

Source: The Study Team

5.6 Roles of Road Operator (for Service Contract)

From the discussion on frameworks foregoing, roles of the Road Operator are sorted out as shown below for the service contract. Where, the Public Road Owners or Investor has been assigned respectively to the following sections in the Project Scope:

- VEC-O&M: Cau Gie–Ninh Binh
- O&M Company under HPC: Ring Road 3, Lang–Hoa Lac and Noi Bai–Ca Lo Bridge
- O&M Company under Bac Ninh Province: Ca Lo Bridge–Bac Ninh.

Table 5.5 Roles of Road Operator

Items		Center Subsystem						Roadside Subsystem	On-board Subsystem	Mobile Subsystem	In-door Subsystem
		Regional Main Center	Data Integration Center	Road Management Office	Toll Office	Road Owner's Head Office	OBU Registration Office				
Functional Packages											
1	Voice Communication			XX	XX			XX			
2	CCTV Monitoring			XX				XX			
3	Event Detection (by Image)			XX				XX			
4	Vehicle Detection			XX				XX			
5	Traffic Analysis										
6	Weather Monitoring							XX			
7	Traffic Event Data Management			XX							
8	Traffic Supervision										
9	VMS Indication							XX			
10	Mobile Radio Communication			XX					XX	XX	
11	Traffic Information										
12	Integrated Data Management										
13	Tollgate Lane Monitoring				XX			XX			
14	Vehicle/Class Identification							XX			
15	Lane Control							XX			
16	Road-to-Vehicle Communication							XX			
17	IC-card Recording							XX			
18	Toll Data Management				XX						
19	OBU Management			XX							
20	Axle Load Measurement							XX			
21	Measurement Lane Monitoring				XX						
Communication System				XX	XX			XX			
Communication Ducts				XX	XX			XX			
Base Structures				XX	XX			XX			
Electric Power Supply				XX	XX			XX			

Note, XX: Operation/maintenance services.

Source: The Study Team

5.7 Roles of Road Operator (for Concession Contract)

From the discussion on frameworks foregoing, roles of the Road Operator are sorted out as shown below for the concession contract. Where, the Public Road Owners or Investor has been assigned respectively to the following sections in the Project Scope:

- BOT under DRVN: Phap Van–Cau Gie and Ha Noi–Bac Giang

Table 5.6 Roles of Road Operator

Items		Center Subsystem						Roadside Subsystem	On-board Subsystem	Mobile Subsystem	In-door Subsystem
		Regional Main Center	Data Integration Center	Road Management Office	Toll Office	Road Owner's Head Office	OBU Registration Office				
Functional Packages											
1	Voice Communication			XX	XX			XX			
2	CCTV Monitoring			XX				XX			
3	Event Detection (by Image)			XX				XX			
4	Vehicle Detection			XX				XX			
5	Traffic Analysis										
6	Weather Monitoring							XX			
7	Traffic Event Data Management			XX							
8	Traffic Supervision										
9	VMS Indication							XX			
10	Mobile Radio Communication			XX					XX	XX	
11	Traffic Information										
12	Integrated Data Management										
13	Tollgate Lane Monitoring				XX			XX			
14	Vehicle/Class Identification							XX			
15	Lane Control							XX			
16	Road-to-Vehicle Communication							XX			
17	IC-card Recording							XX			
18	Toll Data Management				XX						
19	OBU Management			XX							
20	Axle Load Measurement							XX			
21	Measurement Lane Monitoring				XX						
Communication System				XX	XX			XX			
Communication Ducts				XX	XX			XX			
Base Structures				XX	XX			XX			
Electric Power Supply				XX	XX			XX			

Note, XX: All capital investments excluding initial capital investments for existing road section, operation/maintenance services and toll collection.

Source: The Study Team

5.8 Roles of Telecommunication Service Company

Introduction and O&M of communication system is to be outsourced to the telecom service companies for manpower saving in the later stage after the ITS Integration Project, that is proposed by the Decision No.3569/ VPCP-KTN VNPT.

From the discussion on frameworks foregoing, roles of the telecommunication service company are to be sorted out as shown below.

Table 5.7 Roles of Telecommunication Service Company

Items		Center Subsystem						Roadside Subsystem	On-board Subsystem	Mobile Subsystem	In-door Subsystem
		Regional Main Center	Data Integration Center	Road Management Office	Toll Office	Road Owner's Head Office	OBU Registration Office				
Functional Packages											
1	Voice Communication	XX		XX	XX			XX			
2	CCTV Monitoring										
3	Event Detection (by Image)										
4	Vehicle Detection										
5	Traffic Analysis										
6	Weather Monitoring										
7	Traffic Event Data Management										
8	Traffic Supervision										
9	VMS Indication										
10	Mobile Radio Communication			XX					XX	XX	
11	Traffic Information										
12	Integrated Data Management										
13	Tollgate Lane Monitoring										
14	Vehicle/Class Identification										
15	Lane Control										
16	Road-to-Vehicle Communication										
17	IC-card Recording										
18	Toll Data Management										
19	OBU Management										
20	Axle Load Measurement										
21	Measurement Lane Monitoring										
Communication System		XX		XX	XX			XX			
Communication Ducts											
Base Structures											
Electric Power Supply											

Note, XX: Operation/maintenance services, fee collection, working capital funds, rehabilitation costs, establishing performance standards and monitoring conformity.

Source: The Study Team

5.9 Roles of Other Organizations

IC-card recording, which is included prepayment strongly related to toll settlement among several different road owners, is to be operated a bank or an organization permitted by the State Bank (as the case of Decision No.5190/NHNN-TT). OBU Management is to be carried out independently by the Vietnam Register using the deposit and service charge for OBU.

From the discussion on frameworks foregoing, roles of the OBU management organization and the bank are to be sorted out as shown below.

Table 5.8 Roles of Other Organizations

Items		Center Subsystem						Roadside Subsystem	On-board Subsystem	Mobile Subsystem	In-door Subsystem
		Regional Main Center	Data Integration Center	Road Management Office	Toll Office	Road Owner's Head Office	OBU Registration Office				
Functional Packages											
1	Voice Communication										
2	CCTV Monitoring										
3	Event Detection (by Image)										
4	Vehicle Detection										
5	Traffic Analysis										
6	Weather Monitoring										
7	Traffic Event Data Management										
8	Traffic Supervision										
9	VMS Indication										
10	Mobile Radio Communication										
11	Traffic Information										
12	Integrated Data Management										
13	Tollgate Lane Monitoring										
14	Vehicle/Class Identification										
15	Lane Control										
16	Road-to-Vehicle Communication									Bank	
17	IC-card Recording									B	B
18	Toll Data Management										
19	OBU Management						O		O		O
20	Axle Load Measurement						OBU Management Organization				
21	Measurement Lane Monitoring										
Communication System											
Communication Ducts											
Base Structures											
Electric Power Supply											

Note, B: Ownership, all capital investments, operation/maintenance services, establishing performance standards and monitoring conformity, O: Ownership, all capital investments, and operation/maintenance services.

Source: The Study Team

6. Tasks of Expressway Operation

6.1 General

In this chapter, outline of the tasks for expressway operation is illustrated and the Event Trace Diagrams are shown for the element tasks of the three Priority ITS User Services:

- Traffic Information/Control (→ Traffic Information/Control System)
- Non-stop Toll Collection (→ Toll collection/Management System: For Reference)
- Heavy Truck Control (→ Vehicle Weighing System).

6.2 Outline of Traffic Information/Control

1) Triggers of Traffic Information/Control

(1) Receiving Notification by Document

The following traffic events are to be notified by document from the road works contractors and other organizations:

- Construction works
- Special event

(2) Telephone Call

The following traffic events are to be notified by telephone call from the drivers:

- Incident

(3) Administrative Telephone or Radio Communication

The following traffic events are to be notified by administrative telephone or radio communication:

- Incident
- Special event
- Construction work
- Bad weather
- Traffic congestion
- Traffic restriction

(4) Monitoring by CCTV Camera

The following traffic events are to be identified through monitoring by CCTV camera:

- Incident
- Bad weather
- Traffic congestion

(5) Identification by Detectors/Sensors

The following traffic events are to be identified by detectors and sensors:

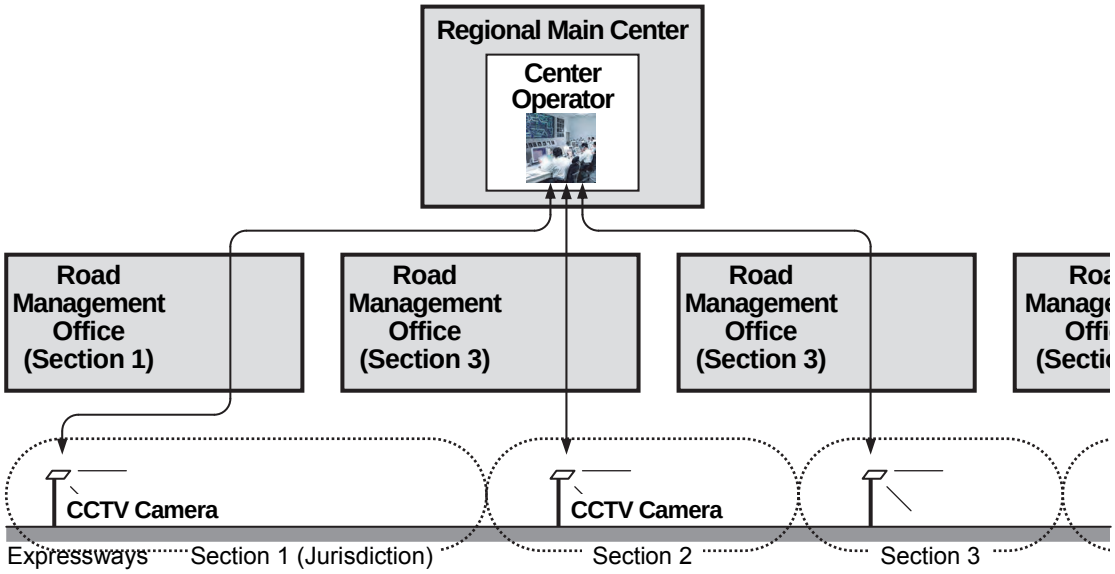
- Incident
- Bad weather
- Traffic congestion
- Traffic restriction

2) Cooperation on Camera Control among Regional Main Center and Road Management Offices

(1) Case-1: Routine Monitoring

Routine road/traffic monitoring is to be delegated to the Regional Main Center for integrating traffic information/control with a wider view on the expressway network. CCTV cameras are to be controlled directly from the Regional Main Center.

Figure 6.1 Routine Monitoring

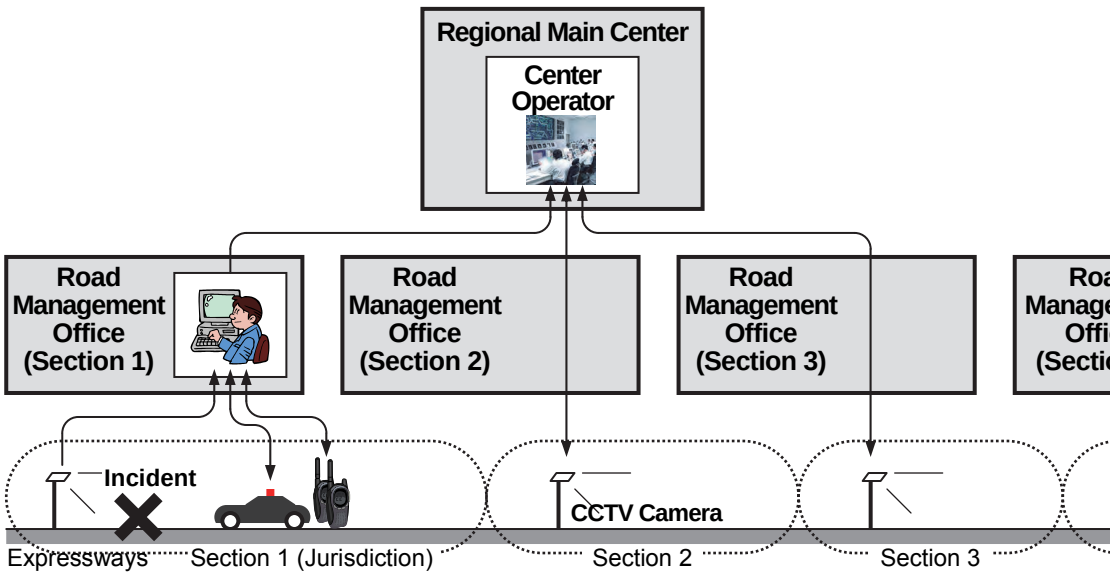


Source: ITS Integration Project (SAPI) Study Team

(2) Case-2: Monitoring at Occurrence of Incident

Road/traffic monitoring at incident site is to be conducted by the road management office in charge to appropriately address/clear the incident. CCTV cameras at incident site are to be controlled from the road management office in charge, and other CCTV cameras and VMS are to be controlled from the Regional Main Center.

Figure 6.2 Monitoring at Occurrence of Incident



Source: ITS Integration Project (SAPI) Study Team

3) Measures of Expressway Operation responding to Incident

The following measures are to be taken for expressway operation responding to incidents:

- Information provision to organization concerned
- Incident handling/clearance by manpower
- Traffic restriction by manpower
- Speed limitation by CSS
- Traffic restriction information by VMS
- Information by VMS

(1) Information Provision to Organization Concerned

Information is to be provided to the traffic police, the fire section, ambulance services, towing services and other offices of road operators concurrently with instruction to the patrol crews. Negotiations with traffic police is necessary for enforcing/removing traffic restrictions.

(2) Incident Handling/Clearance by Manpower

Incident handling and clearance is to be conducted mainly by manpower as shown in the picture below.

Figure 6.3 Incident Handling/Clearance by Manpower

Source: ITS Integration Project (SAPI) Study Team

(3) Traffic Restriction by Manpower

Traffic restriction is to be conducted mainly by manpower as shown in the picture below.

Figure 6.4 Traffic Restriction by Manpower

Source: ITS Integration Project (SAPI) Study Team

(4) Speed Limitation by CSS

Speed limitation is to be disseminated by indication using CSS.

Table 6.1 Speed Limitation by CSS

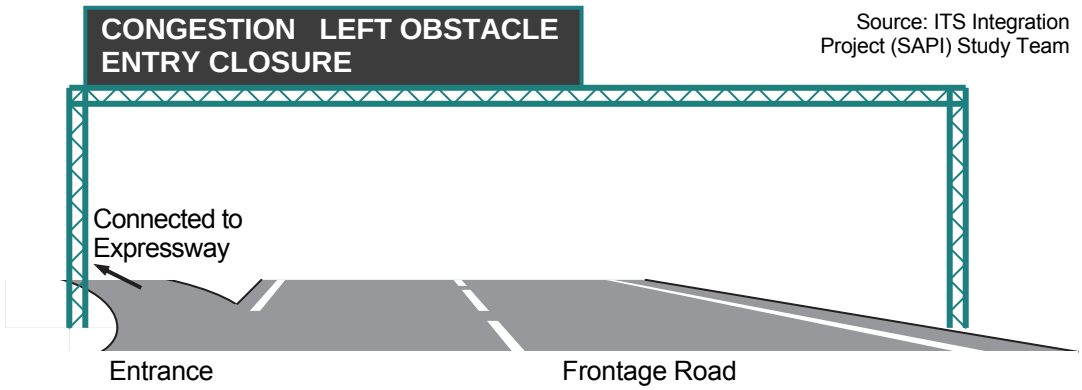
CSS Indication	Closure	Speed limit at 50 km/h	Speed limit at 80 km/h
Heavy Rain	More than 40 mm/h	More than 20 mm/h	More than 15 mm/h
High Wind	More than 20 m/sec	More than 15 m/sec	More than 10 m/sec
Dense Fog	Visibility less than 50 m	Visibility less than 50 m	Visibility less than 50 m

Source: ITS Integration Project (SAPI) Study Team

(5) Traffic Restriction Information by VMS

Traffic restriction information is to be disseminated by indication using VMS. Entry closure shown in the figure below is a typical example of it.

Figure 6.5 VMS Indication for Entry Closure



(6) Guidance Information by VMS

Guidance information is to be disseminated by indication using VMS. Instruction of going out at the exit as shown in the figure below is a typical example of it.

Figure 6.6 VMS Indication for Through Lanes Closure

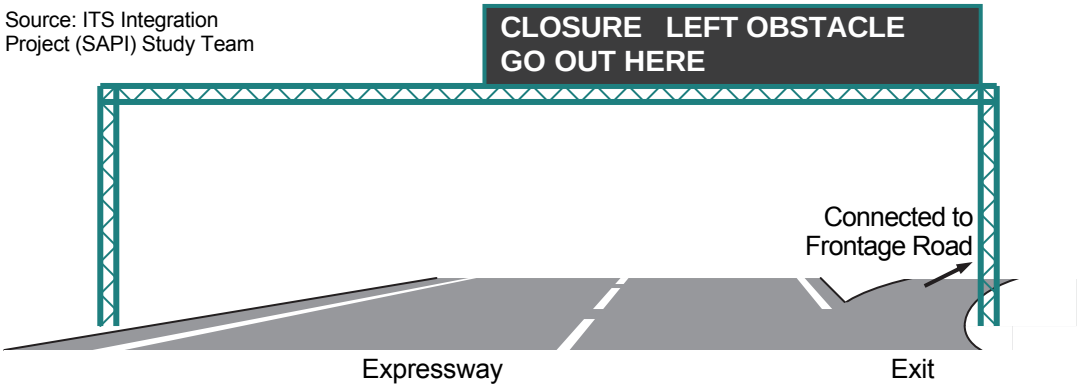


Table 6.2 Definition of Traffic Events including Correlations

Category	Traffic Event		Definition	Traffic Event to be Correlated												
Special Event	Special Event		Special event which may prevent vehicle traffic	X	X	X	X	X	X	X	X	X	X	X	X	X
Incident	Traffic Accident		Serious traffic accident	X	X	X	X	X	X	X	X	X	X	X	X	X
	Incident in Tunnel		Incident in tunnel including fire	X	X	X	X	X	X	X	X	X	X	X	X	X
	Reverse Driving		Vehicle driven in the reverse direction	X	X	X	X	X	X	X	X	X	X	X	X	X
	Broken-down Vehicle		Vehicle stopping on the road	X	X	X	X	X	X	X	X	X	X	X	X	X
	Left Obstacle		Object* on the road which may prevents vehicle traffic	X	X	X	X	X	X	X	X	X	X	X	X	X
	Natural Disaster		Natural disaster which may prevent vehicle traffic	X	X	X	X	X	X	X	X	X	X	X	X	X
	Vandalism		Wilful destruction of facilities or obstruction to traffic on the road	X	X	X	X	X	X	X	X	X	X	X	X	X
Construction Work	Construction Work		Construction work which may prevent vehicle traffic	X	X	X	X	X	X	X	X	X	X	X	X	X
Bad Weather	Heavy Rain	1	Heavy rain more than 40 mm/h**	X	X	X	X	X	X	X	X	X				
		2	Heavy rain more than 20 mm/h**	X	X	X	X	X	X	X					X	
		3	Heavy rain more than 10 mm/h**	X	X	X	X	X	X	X						X
	High Wind Figure 9.1.1	1	High wind more than 25 m/sec** on average	X	X	X	X	X	X	X	X	X				
		2	High wind more than 20 m/sec** on average	X	X	X	X	X	X	X					X	
		3	High wind more than 10 m/sec** on average	X	X	X	X	X	X	X						X
	Dense Fog	1	Dense fog with visibility less than 50 m**	X	X	X	X	X	X	X	X	X				
		2	Dense fog with visibility less than 100 m**	X	X	X	X	X	X	X					X	
		3	Dense fog with visibility less than 200 m**	X	X	X	X	X	X	X						X
	High Temperature		High temperature more than 40 degrees C**													
Traffic Congestion	Congestion on Trough Lanes	1	VS continuously slower than 40 km/h*** on av. with VQ longer than 4 km													
		2	VS continuously slower than 40 km/h*** on av. with VQ longer than 2 km													
		3	VS continuously slower than 40 km/h*** on av. with VQ longer than 1 km													
	Crowdedness on Trough Lanes		VS slower than 50 km/h*** on av. with no or short VQ													
	Congestion at Exit	1	VS continuously slower than 40 km/h*** on av. with VQ longer than 4 km at exit													
		2	VS continuously slower than 40 km/h*** on av. with VQ longer than 2 km at exit													
		3	VS continuously slower than 40 km/h*** on av. with VQ longer than 1 km at exit													
Traffic Restriction	Entry Closure		Restriction to stop inflow traffic at entrance													
	Throughlanes Closure		Restriction to stop traffic on through lanes													
	Exit Closure		Restriction to stop traffic at exit													
	Lane Closure		Restriction to stop through traffic partially on some lanes													
	Speed Limitation	1	Restriction to limit the fastest vehicle speed less than 50 km/h													
		2	Restriction to limit the fastest vehicle speed less than 80 km/h													

Note: VS: Vehicle speed, VQ : Vehicle queuing, * : Excluding vehicles, ** : Specific definition is shown Appendix 4, *** : Specific definition is shown Appendix 4.

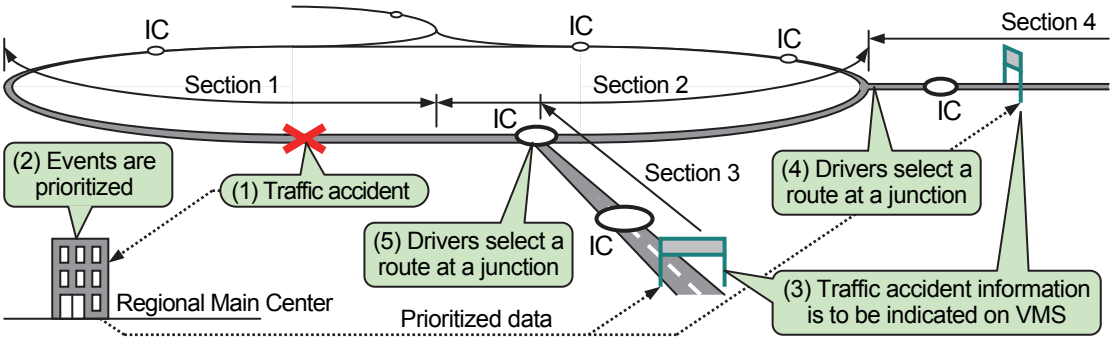
Source: ITS Integration Project (SAPI) Study Team

4) Prioritisation of Traffic Events

Traffic information is to be provided from the regional main center to the drivers over the whole expressway network by using the traffic event data with a total prioritization based on the following attributes:

- Categories and classes of the traffic events which have occurred at the same time period
- Current position of a driver relative to the sites of the traffic events which have occurred on the whole expressway network
- Ratio of the traffic volume which will move from the current position of the driver to the sites of traffic events.

Figure 6.7 Integrated Incident Information with Prioritization

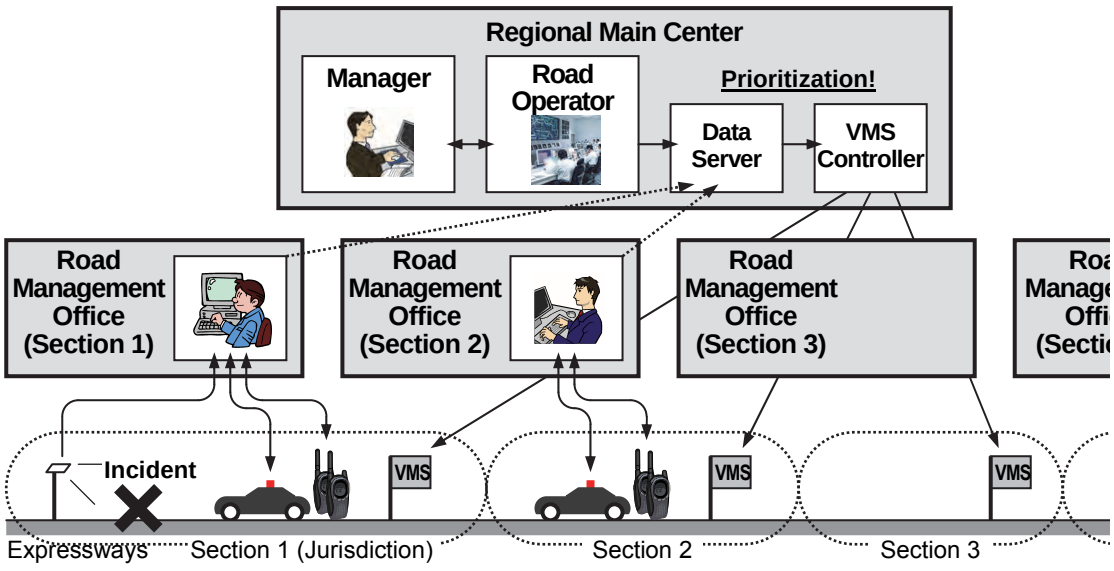


Source: The Study Team

5) Cooperation on VMS Control among Regional Main Center and Road Management Offices

Cooperation of the Regional Main Center and road management office is necessary for VMS control.

Figure 6.8 Cooperation for VMS Control



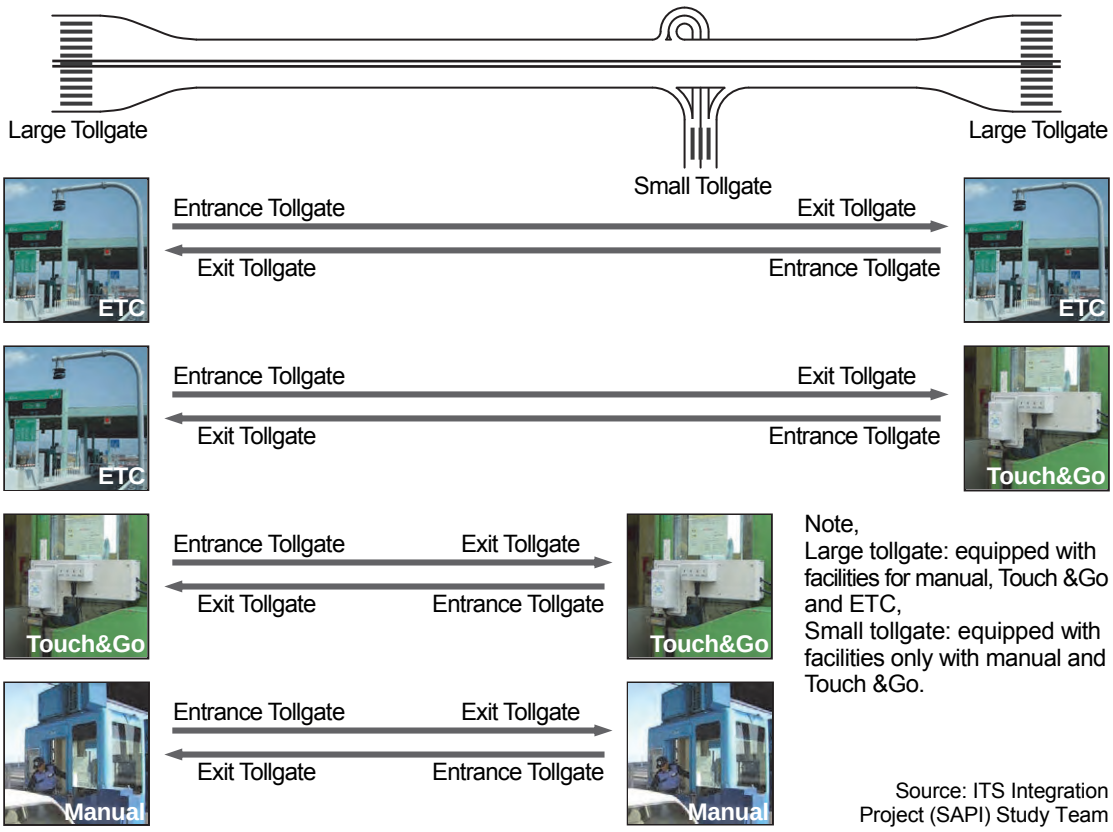
Source: ITS Integration Project (SAPI) Study Team

6.3 Outline of Toll collection/Management

1) Combined Use of ETC and Touch&Go

Available combined use of the means for toll collection at entrance and exit are shown below. The combination use of ETC and Touch&Go is required for reducing the cost of roadside equipment implementation.

Figure 6.9 Available Combined Use of Means for Toll Collection at Entrance/Exit



Toll collection, enforcement and management are to be performed using the required data shown in the table below.

Table 6.3 Required Data for Toll Collection/Enforcement/Management

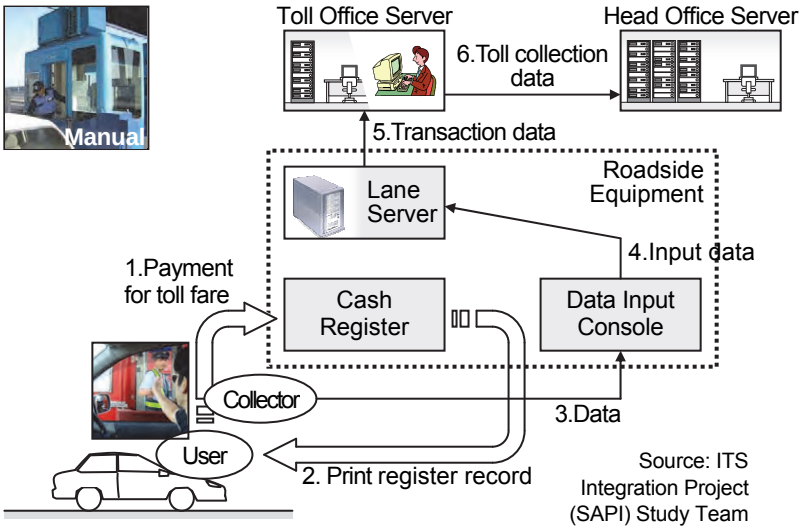
	Procedure	Required Data
Toll Collection	Toll Collection at Manual Lane	Transaction data, Toll collection data
	Toll Collection at Touch&Go Lane	IC-card data, Transaction data, Toll collection data
	Toll Collection at ETC Lane	OBU data, IC-card data, Transaction data, Toll collection data
Toll Enforcement	Monitoring by Video Image	Video image data
	Enforcement Support	Transaction data, License number data (digit/image)
Toll Management	Management Data Download	OBU registration/invalidation list, IC-card issue/ invalidation list
	Transaction Data Acquisition	Transaction data
	Operation Status Monitoring	Operation status
	Toll Collection Data Generation	Transaction data, Toll collection data
	Toll Settlement	Transaction data, Toll collection data, Toll revenue data

2) Toll Collection

(1) Toll Collection at Manual Lane

Toll collection is to be performed using cash at the manual lanes.

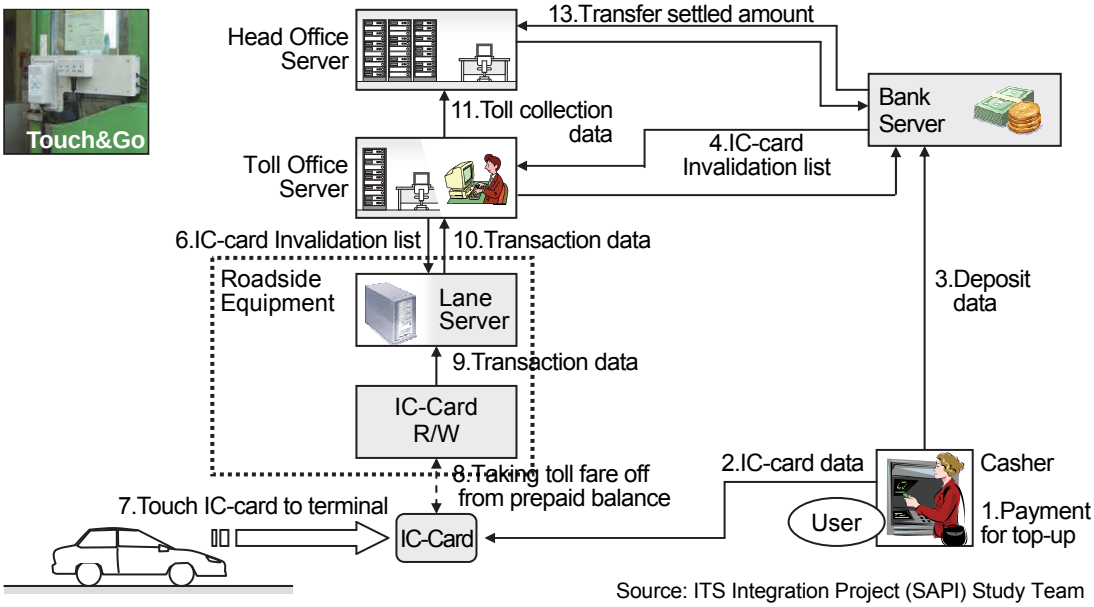
Figure 6.10 Toll Collection Procedure at Manual Lane



(2) Toll Collection at Touch&Go Lane

Toll collection is to be performed using prepaid IC-card at the Touch&Go lanes.

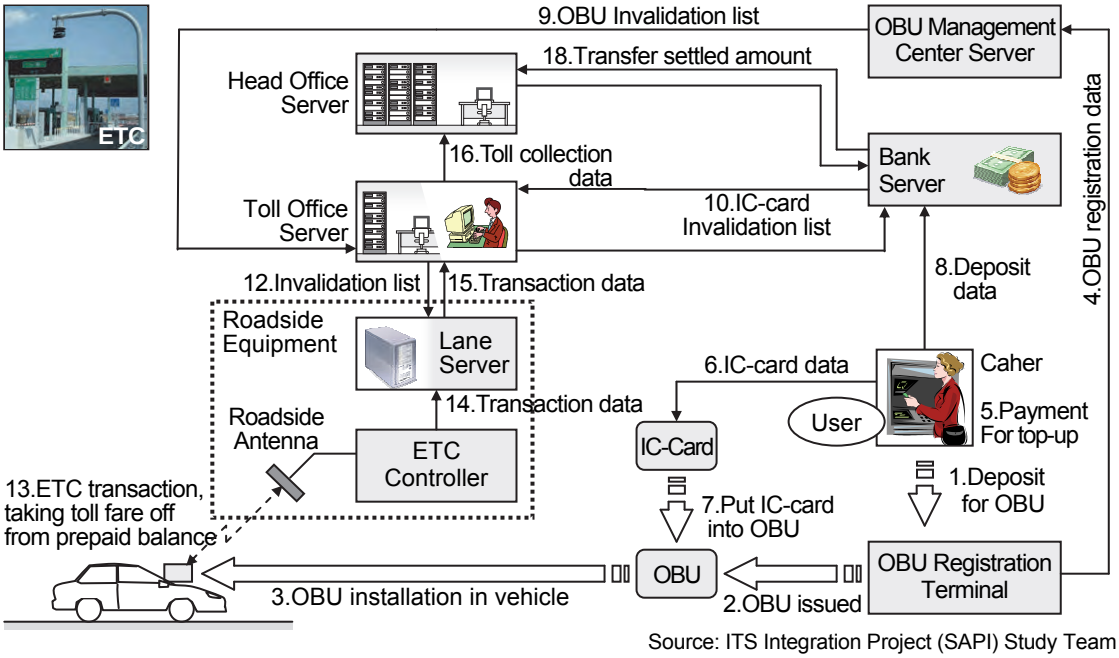
Figure 6.11 Toll Collection Procedure at Touch&Go Lane



(3) Toll Collection at ETC Lane

Toll collection is to be performed using OBU with prepaid IC-card at the ETC lanes.

Figure 6.12 Toll Collection Procedure at ETC Lane



Source: ITS Integration Project (SAPI) Study Team

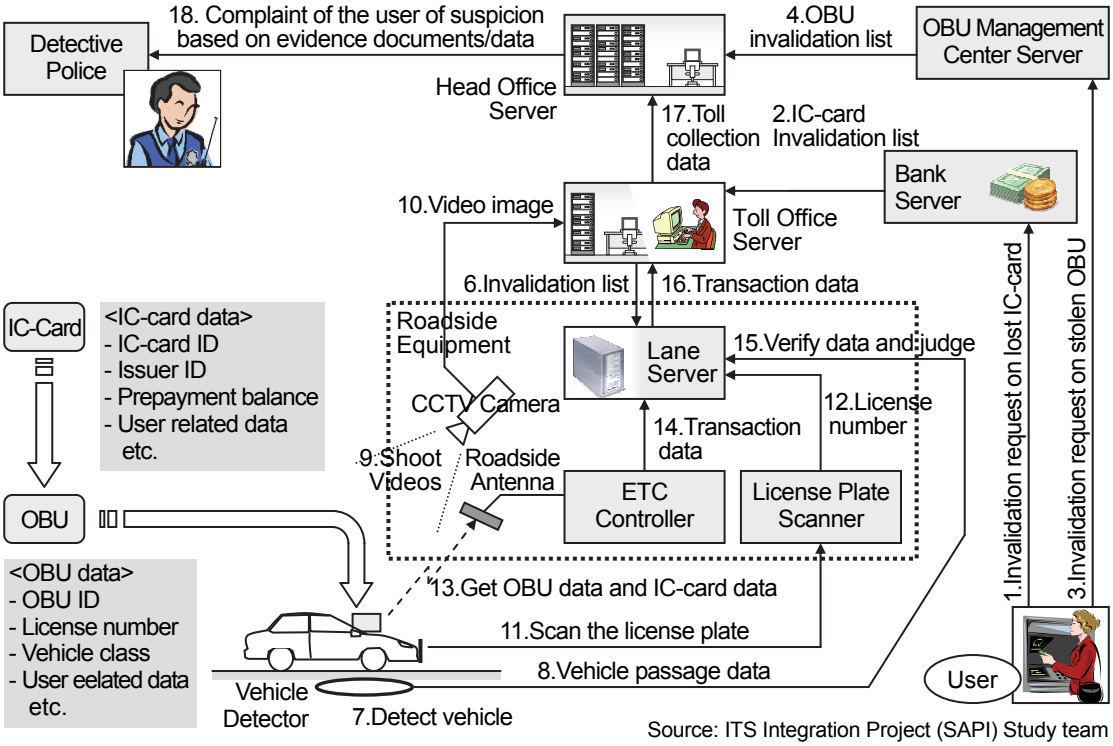
3) Toll Enforcement

(1) Monitoring by Video Image

The System in the toll office is to provide the staff with the video image shot by the camera to keep track of vehicle passages continuously at the tollgate and to allow for proper toll collection.

(2) Enforcement Support

Figure 6.13 Procedure of Toll Enforcement



Source: ITS Integration Project (SAPI) Study team

The System is to receive transaction data at the tollgate which allows a search of suspicious vehicles referring to the license numbers obtained by scanner or CCTV camera and supports toll enforcement.

4) Toll Management

(1) Management Data Download

The System is to download the latest toll rate table to all tollgate lanes at the revision of tariff system for putting the new tariff system into operation. The System is to download invalidation list , as well, which may include ID of stolen OBU or IC-card with shortage in balance.

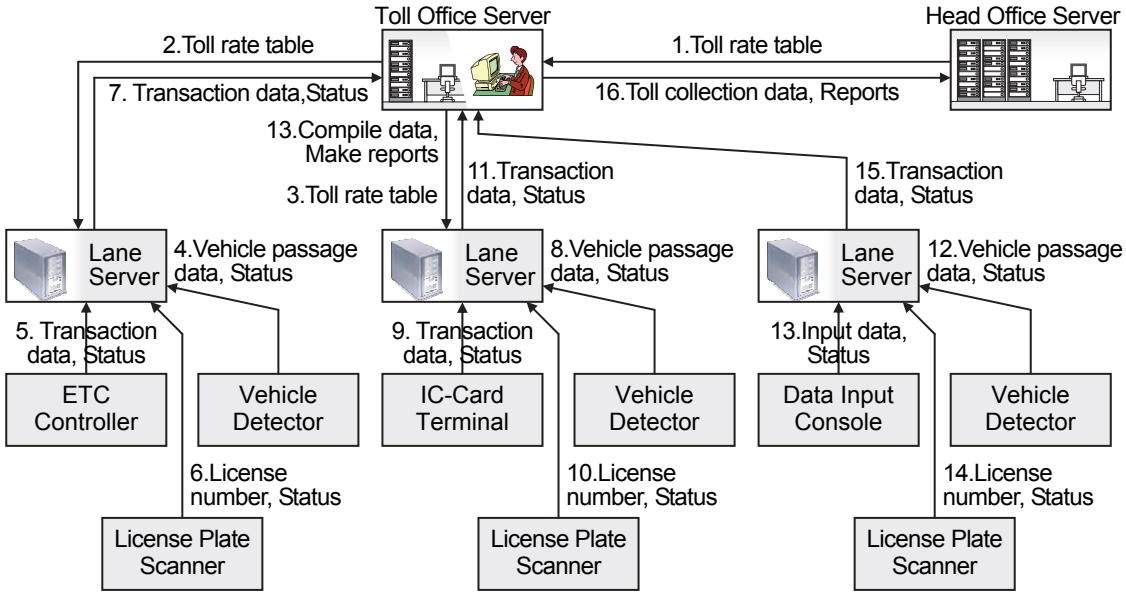
(2) Transaction Data Acquisition

The System is to acquire all transaction data periodically from the lane servers and transfer them to the bank server to find unlawful passages.

(3) Operation Status Monitoring

The System is to monitor the operation status of all toll related equipment to support maintenance action. If abnormal status is detected, the System is to alert on maintenance terminal.

Figure 6.14 Procedure of Toll Management



Source: ITS Integration Project (SAPI) Study Team

(4) Toll Collection Data Generation

The System is to generate the data statistically and make any kind of toll collection reports such as a daily report, a weekly report, a monthly report, and a yearly report. The System is to upload them to the head office to claim for toll revenue to the bank. All data in the System is to be printed out for audit purposes.

6.4 Outline of Vehicle Weighing

1) Overloading Regulation

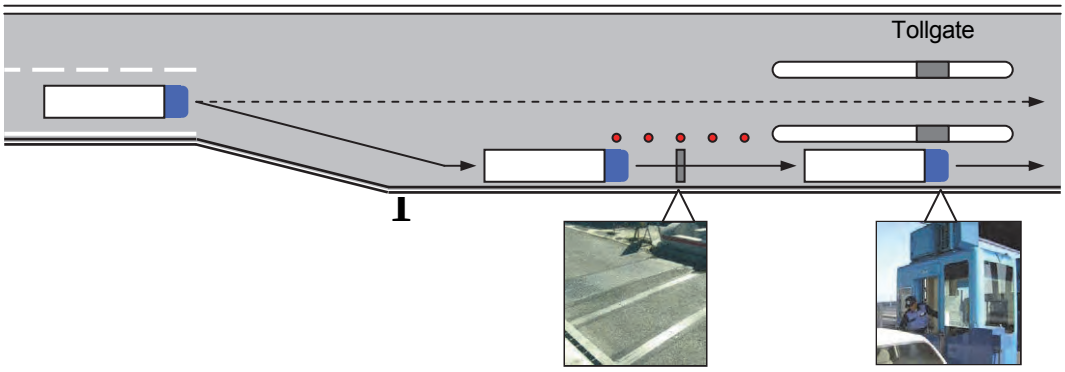
Overloaded vehicles operating on expressways cause significant, severe damages to road and pavement structures of the expressway. As such, in order to protect the road and pavement structures from damages, the Road Operators detect overloaded vehicles, expel the overloaded vehicles from expressways and give cautionary notices to the vehicle owners for the purpose of reducing entry of overloaded vehicles to expressways.

However, it is stipulated (by law) that overloading regulation is to be implemented through cooperation of the Traffic Police and the Road Inspector. The Vehicle Weighing System is to be installed for providing data necessary for overloading regulation to the Road Inspector or the Road Operator as the preparatory step of regulation.

2) Vehicle Weighing

Vehicle Weighing is actualised by the procedure shown in the figure below.

Figure 6.15 Procedure of Overloading Regulation



Source: ITS Integration Project (SAPI) Study Team

In measuring vehicle weight for overloading regulation, it is necessary to measure not only the axle loads but also gross weight of vehicles. However, it is planned that axle load measuring equipment only are provided at expressway toll gates and that the gross weight of vehicles will be worked out by calculations.

3) Controlled Exit of Overloaded Vehicles

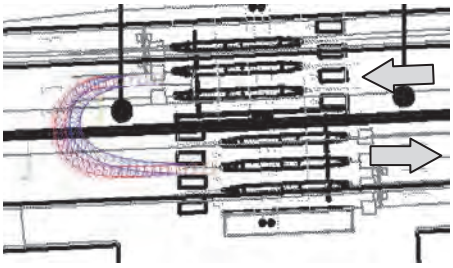
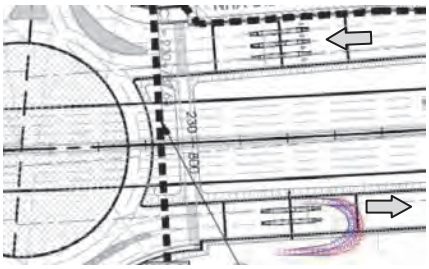
Overloaded vehicles detected need to be expelled from expressways immediately. Methods of expelling the overloaded vehicles will be either (1) exit by U-turning before entering or (2) exit from the nearest interchange after entering. For expressway traffic safety, reverse driving and head-on (wrong-way) driving on expressways, even for the purpose of exiting, must be avoided.

(1) Case of Rejection by U-turn

Table 2 below shows the differences in U-turning operations depending on road arrangements/ gate types.

In the case of integrated type toll gate of with 3 or more lanes each way, U-turning of vehicles of up to semi-trailer size is possible; however, in the case of divided type toll gate, spaces for making U-turns before entering is not sufficient; therefore, an off-ramp must be added for expelling overloaded vehicles.

Table 6.4 Rejection by U-turn for Two Types of Tollgates

	Integrated Type Tollgates (Example: Barrier Tollgates)	Divided Type Tollgates (Example: Diamond-shaped IC tollgates)
Summary	As inbound and outbound ways are not physically separated, U-turning of vehicles of up to semi-trailer size is possible if 3 or more lanes are provided each way.	As inbound and outbound ways are physically separated and no space is available for U-turning of vehicles of semi-trailer size, the overloaded vehicles must be instructed to exit at the nearest IC. No stationing of traffic control personnel at the gates is needed.
Issues	During U-turning, the overloaded vehicles obstruct other vehicles, and cause traffic congestion. Stationing of traffic control personnel is needed.	Because inbound and outbound ways are separated, U-turning is physically difficult and provision of additional exit difficult because of unavailability of land property; thus, construction of the additional exit is almost impossible.
Figure		

Note: The vehicular swept path shown is for "Semi-Trailer" size of dimensions shown in Table 3 below.

(2) Case of Rejection at Subsequent Interchange

The vehicle overloaded is to be permitted to enter the expressway only after the driver of the vehicle is instructed surely to exit at the subsequent interchange.

In case of this operation, there can be few effects to confirm that the vehicles have exited as instructed, because the overloaded vehicles can be driven a certain distance before reaching the subsequent interchange.

6.5 Elemental Tasks

The elemental tasks of expressway operation are listed in the table below. The discussion results on the event trace diagrams of these element tasks are shown in the following pages.

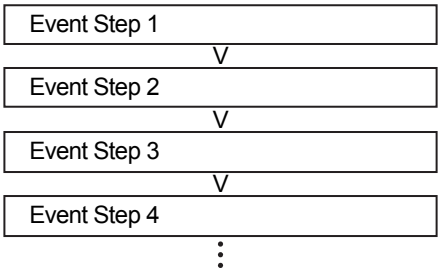
Table 6.4 Element Task List of Expressway Operation

Name of System	No.	Elemental Tasks
Traffic Information/Control	6.6.1	Incident Reporting
		- Incident Reporting by Mobile Phone (113 Call)
		- Incident Reporting by Mobile Phone (115 Call)
		- Incident Reporting by Mobile Phone (to Private Hospital)
		- Incident Reporting by Mobile Phone (to Regional Main Center)
	6.6.2	Identification by Camera
		- Incident Identification
		- Stopped Vehicle Identification
		- Reverse Driving Identification
		- Left Obstacle Identification
	6.6.3	Bad Weather Identification
		- Heavy Rain
		- High Wind
		- Dense Fog
		- High Temperature
	6.6.4	Incident Situation Ascertainment
	6.6.5	Traffic Condition Monitoring
	6.6.6	Traffic Data Management
	6.6.7	Construction Work Information Handling
	6.6.8	Decision of Traffic Restriction
		- Serious Incident/Event
		- Slight Incident/Event
	6.6.9	Decision of Restriction Removal
		- Serious Incident/Event
		- Slight Incident/Event
	6.6.10	Patrol/Supervision
		- Routine Patrol
		- Incident Reporting from Patrol
		- Flood Reporting
		- Road Damage Reporting
		- Vandalism Reporting
		- Incident Handling
		- Incident Clearance Reporting
		- Traffic Supervision Implementation
		- Entry Closure
		- Troughlanes Closure
		- Exit Closure
		- Lane Closure
		- Speed Restriction
		- Restriction Removal Reporting

	6.6.11	Traffic Event Management in Regional Main Center
	6.6.12	Traffic Event Management in Road Management Office
	6.6.13	Traffic Event Management by Patrol Crew
	6.6.14	Traffic Information Indication on VMS
	6.6.15	Traffic Information by Internet
	6.6.16	Traffic Information by Broadcast
	6.6.17	Traffic Information Cancellation
	6.6.18	Integrated Data Management
Automated Toll Collection /Management	6.7.1	Toll Collection at Manual Lane
	6.7.2	Toll Collection at Touch&Go Lane
		- Normal Case
		- Balance Shortage
	6.7.3	Toll Collection at ETC Lane
		- Normal Case
		- Balance Shortage
	6.7.4	Handling of Vehicle without OBU into ETC Lane
	6.7.5	Handling of OBU Reinstalled Illegally
	6.7.6	Tollgate Lane Monitoring by Camera
	6.7.7	Toll Data Management
	6.7.8	Toll Settlement
	6.7.9	IC-card Management
		- Issuance
		- Invalidation
	6.7.10	Top-up of Prepaid Balance
	6.7.12	OBU Management
		- Registration
		- Invalidation
	6.7.12	Toll Enforcement Assistance
Vehicle Weighing	6.8.1	Axle Load Measurement
		- Normal Case
		- Penalty for Overloading
	6.8.2	Measurement Lane Monitoring by Camera
	6.8.3	Axle Load Data Management
	6.8.4	Overloading Regulation by Post-treatment

The elemental asks above are to be specified using the event tracing diagrams, which composed of a series of event steps, in the following pages.

Figure 6.16 Event Tracing Diagram



6.6 Traffic Information/Control

6.6.1 Incident Reporting

Incident Reporting by Mobile Phone (113 Call)

Preconditions & Outline: A road user finds out an incident onsite at the expressway, and the user is to utilize a mobile phone to make an emergency call (113 Call) to the traffic police operation center.

Event Steps:

A road user finds out an incident on an expressway.

V

The road user makes a 113 Call by mobile phone.

V

The road user reports the situation and the place of the incident to an operator of the 113 Call Center.

V

The operator of the 113 Call Center informs the incident occurrence to the expressway police in the competent road management office.

V

The expressway police go into action at the incident site.

V

The expressway police share the incident occurrence with the expressway ambulance in the road management office In case with injured persons.

V

The expressway police share the incident occurrence with the road operator in the road management office.

V

The road operator inputs the situation of incident into the System to share it with the Regional Main Center.

V

The road operator takes necessary actions for incident handling.

Notes of reference for underlined words:
- Incident→ Figures 3.7, 3.10, Table 6.2
- 113 call center→ Figures 3.5
- Expressway police→ Figures 3.4, 3.5, 3.6
- Expressway ambulance→ Figures 3.1, 3.4, 3.7
- Road operator→ Figures 3.1, 3.4, 3.5
- Road management office→ Figures 3.1, 3.4, 3.5
- Regional Main Center→ Figures 3.1, 3.4, 3.5

Incident Reporting by Mobile Phone (115 Call)

Preconditions & Outline: A road user finds out an incident with injured persons onsite at the expressway, and the user is to utilize a mobile phone to make an emergency call (115 Call) to a provincial ambulance service center.

Event Steps:

A road user finds out an incident with injured persons on the expressway.	
∨	
The road user makes a 115 call by mobile phone and reports the place and the severity of injured persons.	
∨	
The operator of the 115 call center informs the incident occurrence to the expressway ambulance in the competent road management office.	
∨	
An ambulance goes into action at the incident site.	
∨	
The expressway ambulance crew shares the incident occurrence with the expressway police and the road operator in the road management office.	
∨	
The road operator inputs the situation of incident into the System to share it with the Regional Main Center.	
∨	
The road operator takes necessary actions for incident handling.	
∨	
∨	

Notes of reference for underlined words:
- Incident→ Figures 3.7, 3.10, Table 6.2
- 115 call center→ Figure 3.6
- Expressway police→ Figures 3.4, 3.5, 3.6
- Expressway ambulance→ Figures 3.4, 3.5, 3.6
- Road operator→ Figures 3.1, 3.4, 3.6
- Road management office→ Figures 3.1, 3.4, 3.6
- Regional Main Center→ Figures 3.1, 3.4, 3.6

Incident Reporting by Mobile Phone (to Private Hospital)

Preconditions & Outline: A road user finds out an incident with injured persons onsite at the expressway, and the user is to utilize a mobile phone to make an emergency call to a private hospital ambulance service center.

Event Steps:

A road user finds out an incident with injured persons on an expressway.	
V	
The road user makes an emergency call to a private hospital ambulance center.	
V	
The private hospital ambulance center dispatches an ambulance to the incident site.	
V	
The private hospital ambulance center sends a call (without area code) to an operator in the Regional Main Center.	
V	
The operator inputs the incident occurrence into the System to share it with the road operator in the competent road management office.	
V	
The road operator shares of the incident occurrence with the expressway police and the expressway ambulance if necessary.	
V	
The road operator takes necessary actions for incident handling.	
V	
V	

Notes of reference for underlined words:
- Incident→ Figures 3.7, 3.10, Table 6.2
- Private hospital ambulance center→ Figure 3.7
- Expressway police→ Figures 3.1, 3.4, 3.7
- Expressway ambulance→ Figures 3.1, 3.4, 3.7
- Road operator→ Figures 3.1, 3.4, 3.7
- Road management office→ Figures 3.1, 3.4, 3.7
- Regional Main Center→ Figures 3.1, 3.4, 3.7

Incident Reporting by Mobile Phone (to Regional Main Center)

Preconditions & Outline: A road user finds out an incident onsite at the expressway, and the user is to utilize a mobile phone to make an emergency call (Special Number Call without area code) to the Regional Main Center.

Event Steps:

A road user finds out an incident on the expressway.	
V	
The road user makes an emergency call to an operator in the Regional Main Center.	
V	
The operator informs the incident occurrence to the road operator in the competent road management office.	
V	
The road operator shares the incident occurrence with the expressway police and the expressway ambulance if necessary.	
V	
The road operator takes necessary actions for incident handling.	
V	
V	
V	
V	

Notes of reference for underlined words:
- Incident→ Figures 3.7, 3.10, Table 6.2
- Provincial 115 Call Center→ Figure 3.6
- Expressway police→ Figures 3.1, 3.4, 3.6
- Expressway ambulance→ Figures 3.1, 3.4, 3.6
- Road operator→ Figures 3.1, 3.4, 3.6
- Road management office→ Figures 3.1, 3.4, 3.6
- Regional Main Center→ Figures 3.1, 3.4, 3.6

6.6.2 Identification by Camera

Incident Identification

Preconditions & Outline: Incident identification is to be made manually using the CCTV cameras installed continuously along the expressway.

Event Steps:

An incident occurs on the expressway.	
V	
An alarm is issued in the Regional Main Center based on the result of image recognition using a CCTV camera.	
V	
An operator in the Regional Main Center recognizes the incident occurrence by the alarm.	
V	
The operator informs the incident occurrence to the road operator in the competent road management office.	
V	
The road operator shares the incident with the expressway police and the expressway ambulance if necessary.	
V	
The road operator despatches patrol crews to the place of stopped vehicle.	
V	
The patrol crew informs location and severity of the incident to the road management office.	
V	
The road operator inputs traffic event data of the incident (incliding the traffic restriction) into the System to share it with the Regional Main Center.	
V	
The patrol crews take necessary actions for traffic control according to the instruction of the road operator.	

Notes of reference for underlined words:
- Incident→ Figures 3.7, 3.10, Table 6.2
- Traffic event→ Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Expressway police→ Figures 3.1, 3.4, 3.7
- Expressway ambulance→ Figures 3.1, 3.4, 3.7
- Road operator→ Figures 3.1, 3.4, 3.7
- Road management office→ Figures 3.1, 3.4, 3.7, 6.8
- Regional Main Center→ Figures 3.1, 3.4, 3.7, 6.8

Stopped Vehicle Identification

Preconditions & Outline: Stopped vehicle identification is to be made automatically by image recognition using the CCTV cameras installed appropriate spots along the expressway.

Event Steps:

A vehicle stopped by breakdown on the expressway.	
∨	
An alarm is issued in the Regional Main Center based on the result of image recognition using a CCTV camera.	
∨	
An operator in the Regional Main Center recognizes the stopped vehicle by the alarm.	
∨	
The operator informs the stopped vehicle to the road operator in the competent road management office.	
∨	
The road operator shares the vehicle stop with the expressway police if necessary.	
∨	
The road operator despatches patrol crews to the place of stopped vehicle.	
∨	
Patrol crews inform location and situation of the stopped vehicle by breakdown to the road management office.	
∨	
The road operator inputs traffic event data of the broken-down vehicle (incliding the traffic restriction) into the System to share it with the Regional Main Center.	
∨	
The patrol crews take necessary actions for traffic control according to the instruction of the road operator.	

Notes of reference for underlined words:
- Broken-down vehicle→ Table 6.2
- Traffic event→ Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Expressway police→ Figures 3.1, 3.4, 3.7
- Road operator→ Figures 3.1, 3.4, 3.7
- Road management office→ Figures 3.1, 3.4, 3.7, 6.8
- Regional Main Center→ Figures 3.1, 3.4, 3.7, 6.8

Reverse Driving Identification

Preconditions & Outline: Reverse driving identification is to be made automatically by image recognition using the CCTV cameras installed at appropriate spots along the expressway.

Event Steps:

A vehicle makes reverse driving on the expressway.	
∨	
An alarm is issued in the Regional Main Center based on the result of image recognition using a CCTV camera.	
∨	
An operator in the Regional Main Center recognizes the reverse driving by the alarm.	
∨	
The operator informs the reverse driving to the road operator in the competent road management office.	
∨	
The road operator shares the reverse driving with the expressway police.	
∨	
The expressway police take a necessary action.	
∨	
The road operator despatches patrol crews to the place of stopped vehicle.	
∨	
The patrol crews take necessary actions for traffic control according to the instruction of the road operator and the expressway police.	
∨	

Notes of reference for underlined words:
- Reverse driving→ Table 6.2
- Expressway police→ Figures 3.1, 3.4, 3.7
- Road operator→ Figures 3.1, 3.4, 3.7
- Road management office→ Figures 3.1, 3.4, 3.7, 6.8
- Regional Main Center→ Figures 3.1, 3.4, 3.7, 6.8

Left Obstacle Identification

Preconditions& Outline: Left obstacle identification is to be made automatically by image recognition using the CCTV cameras installed at appropriate spots along the expressway.

Event Steps:

An obstacle is left on the expressway.	
V	
An alarm is issued in the Regional Main Center based on the result of image recognition using a CCTV camera.	
V	
An operator in the Regional Main Center recognizes the left obstacle by the alarm.	
V	
The operator informs the left obstacle to the road operator in the competent road management office.	
V	
The road operator shares the left obstacle with the expressway police if necessary.	
V	
The road operator despatches patrol crews to the place of left obstacle.	
V	
Patrol crews inform location and situation of the left obstacle to the road management office.	
V	
The road operator inputs traffic event data of the left obstacle (including the traffic restriction) into the System to share it with the Regional Main Center.	
V	
The patrol crews take necessary actions for traffic control according to the instruction of the road operator.	

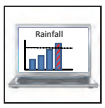
Notes of reference for underlined words:
- Left obstacle → Table 6.2
- Traffic event → Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.7
- Road management office→ Figures 3.1, 3.4, 3.7, 6.8
- Regional Main Center→ Figures 3.1, 3.4, 3.7, 6.8

6.6.3 Bad Weather Identification

Heavy Rain

Preconditions & Outline: Heavy rain is to be identified automatically by sensors installed at appropriate spots along the expressway and its situation can be monitored manually using the CCTV cameras installed continuously along the expressway.

Event Steps:

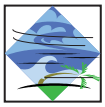
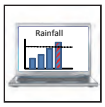
An expressway section is struck by heavy rain.	
V	
An alarm is issued in the Regional Main Center by weather sensors.	
V	
An operator in the Regional Main Center recognizes the heavy rain by the alarm and checks the detected values by the System.	
V	
The operator informs the heavy rain to the road operator in the competent road management office.	
V	
The road operator confirms the situation of the heavy rain to patrol crews.	
V	
Patrol crews inform the situation to the road management office.	
V	
The road operator inputs traffic event data of the heavy rain (including the traffic restriction) into the System to share with the Regional Main Center.	
V	
The patrol crews take necessary actions for traffic control according to the instruction of the road operator.	
V	

Notes of reference for underlined words:
- Heavy rain→ Table 6.2
- Traffic event → Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.8
- Road management office→ Figures 3.1, 3.4, 3.8
- Regional Main Center→ Figures 3.1, 3.4, 3.8

High Wind

Preconditions & Outline: High wind is to be identified automatically by sensors installed at appropriate spots along the expressway and its situation can be monitored manually using the CCTV cameras installed continuously along the expressway.

Event Steps:

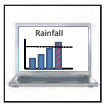
An expressway section is struck by high wind.	
V	
An alarm is issued in the Regional Main Center by weather sensors.	
V	
An operator in the Regional Main Center recognizes the high wind by the alarm and checks the detected values by the System.	
V	
The operator informs the high wind to the road operator in the competent road management office.	
V	
The road operator confirms the situation of the high wind to patrol crews.	
V	
Patrol crews inform the situation to the road management office.	
V	
The road operator inputs traffic event data of the high wind and the traffic restriction into the System to share with the Regional Main Center.	
V	
The patrol crews take necessary actions for traffic control according to the instruction of the road operator.	
V	

Notes of reference for underlined words:
- High wind→ Table 6.2
- Traffic event→ Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Road operator→ Figures 3.1, 3.4
- Road management office→ Figures 3.1, 3.4
- Regional Main Center→ Figures 3.1, 3.4

Dense Fog

Preconditions & Outline: Dense fog is to be identified automatically by sensors installed at appropriate spots along the expressway and its situation can be monitored manually using the CCTV cameras installed continuously along the expressway.

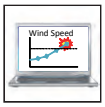
Event Steps:

An expressway section is veiled in dense fog.	
V	
An alarm is issued in the Regional Main Center by weather sensors.	
V	
An operator in the Regional Main Center recognizes the dense fog by the alarm and checks the detected values by the System.	
V	
The operator informs the dense fog to the road operator in the competent road management office.	
V	
The road operator confirms the situation of the dense fog to patrol crews.	
V	
Patrol crews inform the situation to the road management office.	
V	
The road operator inputs traffic event data of the dense fog (including the traffic restriction) into the System to share with the Regional Main Center.	
V	
The patrol crews take necessary actions for traffic control according to the instruction of the road operator.	
V	

Notes of reference for underlined words:
- Dense fog→ Table 6.2
- Traffic event→ Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Road operator→ Figures 3.1, 3.4
- Road management office→ Figures 3.1, 3.4
- Regional Main Center→ Figures 3.1, 3.4

High Temperature

Preconditions & Outline: High temperature is to be identified automatically by sensors installed at appropriate spots along the expressway and its situation can be monitored manually using the CCTV cameras installed continuously along the expressway.

Event Steps:		
	An expressway section gets hit by high temperature.	
	V	
	An alarm is issued in the Regional Main Center by weather sensors.	
	V	
	An operator in the Regional Main Center recognizes the high temperature by the alarm and checks the detected values by the System.	
	V	
	The operator confirms the dense fog to the road operator in the competent road management office.	
	V	
	V	
	V	
	V	
	V	

Notes of reference for underlined words:
- High temperature→ Table 6.2
- Traffic event→ Table 6.2
- Road management office→ Figures 3.1, 3.4
- Regional Main Center→ Figures 3.1, 3.4

6.6.4 Incident Situation Ascertainment

Preconditions & Outline: Incident situation is to be ascertained manually using the CCTV cameras installed continuously along the expressway.

Event Steps:

The road operator at a road management office gets alarm or receives information of an incident.	
V	
The road operator ascertains the incident situation by CCTV monitoring.	
V	
The road operator gets report on the incident situation from patrol crews.	
V	
The road operator inputs the situation of incident into the System to share it with the Regional Main Center.	
V	
The operator in the Regional Main Center checks validity of the traffic event data by CCTV monitoring.	
V	
V	
V	
V	

Notes of reference for underlined words:
- Incident→ Figures 3.7, 3.10, Table 6.2
- Traffic event→ Table 6.2
- Expressway police→ Figures 3.1, 3.4, 3.7
- Expressway ambulance→ Figures 3.1, 3.4, 3.7
- Road operator→ Figures 3.1, 3.4, 3.7
- Road management office→ Figures 3.1, 3.4, 3.7, 6.8
- Regional Main Center→ Figures 3.1, 3.4, 6.8

6.6.5 Traffic Condition Monitoring

Preconditions & Outline: Traffic condition is to be monitored manually using the CCTV cameras installed continuously along the expressway and automatically by traffic analysis based on the data of vehicle detection.

Event Steps:

Traffic congestion occurs on the expressway.	
∨	
The road operator identifies congested section by CCTV monitoring.	
∨	
The road operator inputs traffic event data of the traffic congestion into the System.	
∨	
The operator in the Regional Main Center checks validity of the traffic event data based on the results of traffic analysis.	
∨	
The operator and a manager in the Regional Main Center decide the class of needed traffic restriction based on the regulations pre-defined.	
∨	
The operator informs the class of the traffic restriction to the road management office.	
∨	
The road operator takes necessary actions such as entry closure.	
∨	
∨	

Notes of reference for underlined words:
- Traffic congestion→Table 6.2
- Traffic event→ Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Entry closure→ Table 6.2
- Road operator→ Figures 3.2, 3.4, 6.8
- Road management office→ Figures 3.1, 3.4, 6.8
- Regional Main Center→ Figures 3.1, 3.4, 6.8

6.6.6 Traffic Data Management

Preconditions & Outline: Traffic data are to be accumulated continuously in the System by being input manually or detected/generated automatically.

Event Steps:

Traffic data are automatically collected through vehicle detection and other sensors roadside equipment on the expressway.	
V	
Traffic data are stored in the System.	
V	
The operator in the Regional Main Center checks traffic data.	
V	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Traffic data→ Figures 3.9, 3.19
- Regional Main Center→ Figures 3.1, 3.4, 6.8

6.6.7 Construction Work Information Handling

Preconditions & Outline: Construction work and the class of traffic restriction required for it is to have been decided in other task of expressway operation in advance.

Event Steps:

A company submit a report of construction work on the expressway to the road operator in a road management office.	
V	
The road operator shares the fact of construction work to the expressway police.	
V	
The road operator checks validity of the construction work decides the class of needed traffic restriction.	
V	
The road operator gives permission for the construction work with instruction of traffic restriction to the company.	
V	
The road operator inputs traffic event data of the construction work into the System to share it with the Regional Main Center.	
V	
The road operator despatches patrol crews to the place of construction work.	
V	
The patrol crews take necessary actions for traffic control according to the instruction of the road operator and the expressway police.	
V	
V	

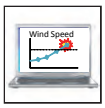
Notes of reference for underlined words:
- Construction work→ Table 6.2
- Traffic event→ Table 6.2
- Traffic restriction → Figure 3.8, Table 6.2
- Expressway police→ Figures 3.1, 3.4, 3.7
- Road operator→ Figures 3.1, 3.4, 3.7
- Road management office→ Figures 3.1, 3.4, 3.7
- Regional Main Center→ Figures 3.1, 3.4, 3.7

6.6.8 Decision of Traffic Restriction

Serious Incident/Event

Preconditions & Outline: The occurrence of a serious incident/event is to have been identified in other task in advance, and the class of traffic restriction is to be decided by the manager in the Regional Main Center responding to its severity and situation.

Event Steps:

An operator in the Regional Main Center checks traffic conditions and events on the expressway network shown on the main monitor screen.	
V	
The operator in the Regional Main Center checks the traffic event data input by the road operator in a road management office.	
V	
The operator checks the values detected by sensors.	
V	
The operator ascertains the situation the traffic event by CCTV monitoring.	
V	
The operator and a manager in the Regional Main Center discuss the class of needed traffic restriction based on the regulations pre-defined.	
V	
The manager in the Regional Main Center decides the appropriate traffic restriction.	
V	
The operator instructs (or permits) the class of the traffic restriction to the road management office.	
V	
V	

Notes of reference for underlined words:
- Incident→ Figures 3.7, 3.10, Table 6.2
- Traffic event→ Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.8
- Road management office→ Figures 3.1, 3.4, 3.8
- Regional Main Center→ Figures 3.1, 3.4, 3.8

Slight Incident/Event

Preconditions & Outline: The occurrence of a slight incident/event is to have been identified in other task in advance, and the traffic restriction is to be decided/executed by the operator in the road management office then to be reported to the Regional Main Center.

Event Steps:

The road operator gets report on the traffic event situation from patrol crews.	
V	
The road operator ascertains the situation the traffic event by a CCTV camera.	
V	
The road operator in the road management office decides the appropriate traffic restriction.	
V	
The road operator instructs (or permits) the class of the traffic restriction to the patrol crews.	
V	
The road operator shares the class of the traffic restriction to the Regional Main Center.	
V	
V	
V	
V	

Notes of reference for underlined words:
- Incident→ Figures 3.7, 3.10, Table 6.2
- Traffic event→ Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.8
- Road management office→ Figures 3.1, 3.4, 3.8
- Regional Main Center→ Figures 3.1, 3.4, 3.8

6.6.9 Decision of Restriction Removal

Serious Incident/Event

Preconditions & Outline: The removal of traffic restriction for a serious incident/event is to be decided by the manager in the Regional Main Center responding to the identification of clearance of the incident/event.

Event Steps:

The patrol crews inform the clearance of traffic event which required the traffic restriction to the road management office.	
V	
The road operator inputs the situation of traffic event into the System to share it with the Regional Main Center.	
V	
The operator in the Regional Main Center ascertains the situation the traffic event by CCTV monitoring.	
V	
The operator and a manager in the Regional Main Center discuss and decide the removal of the traffic restriction.	
V	
The operator instructs the removal of the traffic restriction to the road management office.	
V	
The road operator instructs the removal of the traffic restriction to the patrol crews.	
V	
The patrol crews take necessary actions for the removal of the traffic restriction.	
V	
V	

Notes of reference for underlined words:
- Traffic event → Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.8
- Road management office→ Figures 3.1, 3.4, 3.8
- Regional Main Center→ Figures 3.1, 3.4, 3.8

Slight Incident/Event

Preconditions & Outline: The removal of traffic restriction for a slight incident/event is to be decided/ executed by the operator in the road management office responding to the identification of clearance of the incident/event then to be reported to the Regional Main Center.

Event Steps:

The patrol crews inform the clearance of traffic event which required the traffic restriction to the road management office.	
V	
The road operator in the road management office ascertains the situation the traffic event by CCTV monitoring.	
V	
The road operator instructs the removal of the traffic restriction to the patrol crews.	
V	
The road operator shares the clearance of the traffic restriction to the Regional Main Center.	
V	
The patrol crews take necessary actions for the removal of the traffic restriction.	
V	
V	
V	
V	

Notes of reference for underlined words:
- Traffic event → Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.8
- Road management office→ Figures 3.1, 3.4, 3.8
- Regional Main Center→ Figures 3.1, 3.4, 3.8

6.6.10 Patrol/Supervision

Routine Patrol

Preconditions & Outline: Patrol crews are to be installed at each road management office and to carry out routine patrol.

Event Steps:

The patrol crews patrol over their jurisdiction along the expressway.	
V	
Patrol crews come back to the road management office.	
V	
A patrol crew reports the patrol results to the road operator in the road management office.	
V	
The road operator inputs traffic event data into the System to share it with the Regional Main Center.	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Traffic Event→ Table 6.2
- Road operator→ Figures 3.2, 3.4, 6.8
- Road management office→ Figures 3.1, 3.4, 6.8
- Regional Main Center→ Figures 3.1, 3.4, 6.8

Incident Reporting from Patrol

Preconditions & Outline: A patrol crew finds out an incident onsite at the expressway, and the crew is to report occurrence and situation of the incident to the road management office using radio communication or mobile phone.

Event Steps:

An incident take places on the expressway.	
V	
The patrol crews identify the situation of the incident onsite.	
V	
The patrol crew informs location and severity of the incident to the road management office of incident site.	
V	
The road operator inputs traffic event data of the incident (including the traffic restriction) into the System to share it with the Regional Main Center.	
V	
The road operator shares the incident situation with the expressway police and the expressway ambulance if necessary.	
V	
The expressway police take a necessary action.	
V	
The patrol crews take necessary actions for traffic control according to the instruction of the road operator and the expressway police.	
V	
V	

Notes of reference for underlined words:
- Incident→ Figures 3.7, 3.10, Table 6.2
- Traffic Event→ Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Expressway police→ Figures 3.1, 3.4, 3.6
- Expressway ambulance→ Figures 3.1, 3.4, 3.6
- Road operator→ Figures 3.1, 3.4, 3.6
- Road management office→ Figures 3.1, 3.4, 3.6, 6.8
- Regional Main Center→ Figures 3.1, 3.4, 3.6, 6.8

Flood Reporting

Preconditions & Outline: A patrol crew finds out a flood onsite at the expressway, and the crew is to report occurrence and situation of the flood to the road management office using radio communication or mobile phone.

Event Steps:

An expressway section gets hit by floods.	
V	
Patrol crews identify situation of the floods onsite.	
V	
Patrol crews inform location and situation of the flood to the road management office.	
V	
The road operator inputs traffic event data of the flood (including the traffic restriction) into the System to share it with the Regional Main Center.	
V	
The patrol crews take necessary actions for traffic control according to the instruction of the road operator.	
V	
V	
V	
V	

Notes of reference for underlined words:
- Natural disaster→ Table 6.2
- Traffic event→ Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Road operator→ Figures 3.1, 3.4
- Road management office→ Figures 3.1, 3.4
- Regional Main Center→ Figures 3.1, 3.4

Road Damage Reporting

Preconditions & Outline: A patrol crew finds out a serious road damage onsite at the expressway, and the crew is to report occurrence and situation of the damage to the road management office using radio communication or mobile phone.

Event Steps:

Patrol crews find road damage on an expressway.	
V	
The patrol crews inform situation of the road damage to the road management office.	
V	
The road operator inputs traffic event data of the road damage (including the traffic restriction into the System to share it with the Regional Main Center.	
V	
The patrol crews take necessary actions for traffic control according to the instruction of the road operator.	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Traffic event→ Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.7
- Road management office→ Figures 3.1, 3.4, 3.7, 6.8
- Regional Main Center→ Figures 3.1, 3.4, 3.7, 6.8

Vandalism Reporting

Preconditions & Outline: A patrol crew finds out a vandalism onsite at the expressway, and the crew is to report occurrence and situation of the vandalism to the road management office using radio communication or mobile phone.

Event Steps:

Vandalism takes place on the expressway.	
V	
Patrol crews identify situation of the vandalism onsite.	
V	
Patrol crews inform situation of the vandalism and its location to the road management office.	
V	
The road operator inputs traffic event data of the vandalism into the System to share it with the Regional Main Center.	
V	
The road operator shares the situation of vandalism to the expressway police.	
V	
The expressway police take a necessary action.	
V	
The patrol crews take necessary actions for traffic control according to the instruction of the road operator and the expressway police.	
V	
V	

Notes of reference for underlined words:
- Vandalism→ Table 6.2
- Traffic event → Table 6.2
- Expressway police→ Figures 3.1, 3.4, 2.7
- Road operator→ Figures 3.1, 3.4, 3.7, 6.8
- Road management office→ Figures 3.1, 3.4, 3.7, 6.8
- Regional Main Center→ Figures 3.1, 3.4, 3.7, 6.8

Incident Handling

Preconditions & Outline: Incident handling is to be performed by patrol crews under the instruction of the expressway police and the road operator in the road management office.

Event Steps:

Patrol crews inform the start of incident handling to the road operator in the road management office.	
V	
The patrol crews control traffic at the incident site with the expressway police.	
V	
The patrol crews remove the accident vehicle according to the instruction of the expressway police and the road operator.	
V	
The patrol crews clean up the lanes at the incident site and open them for traffic.	
V	
The patrol crews inform the end of incident handling to the road operator.	
V	
V	
V	
V	

Notes of reference for underlined words:
- Incident→ Figures 3.7, 3.10, Table 6.2
- Expressway police→ Figures 3.1, 3.4, 3.8
- Road operator→ Figures 3.1, 3.4, 3.8
- Road management office→ Figures 3.1, 3.4, 3.8

Incident Clearance Reporting

Preconditions & Outline: Completion of incident clearance is to be reported from the patrol crews to the road operator in the road management office using radio communication or mobile phone, then it is informed to the Regional Main Center.

Event Steps:

The patrol crews inform the clearance of incident to the road operator in the road management office.	
V	
The road operator inputs the clearance of incident into the System to share it with the Regional Main Center.	
V	
The operator in the Regional Main Center ascertains the situation the incident site by CCTV monitoring.	
V	
The operator in the Regional Main Center checks the clearance of incident in the System.	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Incident → Figures 3.7, 3.10, Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.8
- Road management office→ Figures 3.1, 3.4, 3.8
- Regional Main Center→ Figures 3.1, 3.4, 3.8

Traffic Supervision Implementation

Preconditions & Outline: Traffic supervision of expressway is to be carried out by a road operator in association with the expressway police, and its situation is to be shared with the Regional Main Center through the System.

Event Steps:

A road operator in a road management office supervises the traffic conditions on hourly basis shown on the main monitor screen.	
V	
The road operator finds out an incident on an expressway through the monitor and details of incident are confirmed by CCTV monitoring.	
V	
The road operator shares the incident site location with the expressway police and the expressway ambulance in the road management office.	
V	
The road operator despatches patrol crews to the incident site.	
V	
Patrol crews arrive at an incident site with expressway police and/or expressway ambulance.	
V	
Patrol crews inform situation of the incident to the road management office.	
V	
The road operator inputs the situation of incident to the System to share it with the Regional Main Center.	
V	
The patrol crews take necessary actions for traffic control according to the instruction of the road operator.	
V	

Notes of reference for underlined words:
- Incident→ Figures 3.7, 3.10, Table 6.2
- Expressway police→ Figures 3.1, 3.4, 3.7
- Expressway ambulance→ Figures 3.1, 3.4, 3.7
- Road operator→ Figures 3.1, 3.4, 3.7
- Road management office→ Figures 3.1, 3.4, 3.7
- Regional Main Center→ Figures 3.1, 3.4, 3.7

Entry Closure

Preconditions & Outline: Entry closure is to be instructed by the manager in the Regional Main Center to the road operator responding to the situation of the incident/event and to be executed by the road operator.

Event Steps:

The road operator receives instruction (or permission) of an entry closure from the operator in the Regional Main Center.	
V	
The road operator despatches patrol crews to the place of the entry closure.	
V	
The patrol crews take necessary actions for the entry closure.	
V	
The patrol crews take necessary actions for traffic control.	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Incident → Figures 3.7, 3.10, Table 6.2
- Entry closure→ Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.8
- Regional Main Center→ Figures 3.1, 3.4, 3.8

Troughlanes Closure

Preconditions & Outline: Throughlanes closure is to be instructed by the manager in the Regional Main Center to the road operator responding to the situation of the incident/event and to be executed by the road operator.

Event Steps:

The road operator receives instruction (or permission) of an throughlanes closure from the operator in the Regional Main Center.	
V	
The road operator despatches patrol crews to the place of the throughlanes closure on the expressway.	
V	
The patrol crews take necessary actions for the throughlanes closure.	
V	
The patrol crews take necessary actions for traffic control	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Incident → Figures 3.7, 3.10, Table 6.2
- Throughlanes closure→ Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.8
- Regional Main Center→ Figures 3.1, 3.4, 3.8

Exit Closure

Preconditions & Outline: Exit closure is to be instructed by the manager in the Regional Main Center to the road operator responding to the situation of the incident/event and to be executed by the road operator.

Event Steps:

The road operator receives instruction (or permission) of an exit closure from the operator in the Regional Main Center.	
V	
The road operator despatches patrol crews to the place of the exit closure.	
V	
The patrol crews take necessary actions for the exit closure.	
V	
The patrol crews take necessary actions for traffic control.	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Incident → Figures 3.7, 3.10, Table 6.2
- Exit closure→ Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.8
- Regional Main Center→ Figures 3.1, 3.4, 3.8

Lane Closure

Preconditions & Outline: Lane closure is to be executed by the road operator responding to the situation of the incident/event, then reported to the Regional Main Center.

Event Steps:

The patrol crews inform the necessity of lane closure to the road management office.	
V	
The road operator inputs traffic event data of the lane closure into the System to share it with the Regional Main Center.	
V	
The patrol crews take necessary actions for the lane closure control according to the instruction of the road operator.	
V	
The patrol crews take necessary actions for traffic control.	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Incident→ Figures 3.7, 3.10, Table 6.2
- Traffic event→ Table 6.2
- Lane closure→ Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.8
- Road management office→ Figures 3.1, 3.4, 3.8
- Regional Main Center→ Figures 3.1, 3.4, 3.8

Speed Restriction

Preconditions & Outline: Speed restriction is to be instructed by the manager in the Regional Main Center to the road operator responding to the situation of the incident/event and to be executed by the road operator.

Event Steps:

The operator in the Regional Main Center sends indication of speed restriction on CSS and guidance on VMS.	
V	
The road operator receives information of the speed restriction from the operator in the Regional Main Center	
V	
V	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Incident→ Figures 3.7, 3.10, Table 6.2
- Speed restriction→ Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.8
- Regional Main Center→ Figures 3.1, 3.4, 3.8

Restiriction Removal Reporting

Preconditions & Outline: After traffic event finished and traffic condition is recovered to normal, traffic restriction removal is to be reported by a patrol crew on site to the road management office.

Event Steps:

The patrol crews inform the removal of traffic restriction to the road operator in the road management office.	
V	
The road operator inputs the removal of traffic restriction into the System to share it with the Regional Main Center.	
V	
The operator in the Regional Main Center ascertains the situation the traffic conditions by CCTV monitoring.	
V	
The operator in the Regional Main Center checks the removal of traffic restriction in the System.	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Traffic event→ Table 6.2
- Traffic restriction→ Figure 3.8, Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.8
- Road management office→ Figures 3.1, 3.4, 3.8
- Regional Main Center→ Figures 3.1, 3.4, 3.8

6.6.11 Traffic Event Management by Regional Main Center

Preconditions & Outline: After a traffic event occurs on the expressway and is reported to the Regional Main Center, its data is to be input by an operator in the Center and checked by an operator in the road management office.

Event Steps:

The operator in the Regional Main Center inputs the category/class, date/time and location of a traffic event into the System.	
V	
The System indicate the traffic event data on the screen in the Regional Main Center and the competent road management office.	
V	
The road operator in the road management office inputs the detail data of the traffic event into the System.	
V	
The road operator checks the validity of the data and inputs the check flag for the data.	
V	
The operator in the Regional Main Center inputs the data for generating the linkage and priority among the traffic events.	
V	
V	
V	
V	

Notes of reference for underlined words:
- Traffic event→ Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.8
- Road management office→ Figures 3.1, 3.4, 3.9
- Regional Main Center→ Figures 3.1, 3.4, 3.9

6.6.12 Traffic Event Management by Road Management Office

Preconditions & Outline: After a traffic event occurs on the expressway and is reported to the road management office, its data is to be input by an operator in the office and checked by an operator in the Regional Main Center.

Event Steps:

The road operator in the road management office inputs the category/class, date/time and location of a traffic event into the System.	
V	
The road operator inputs the detail data of the traffic event into the System.	
V	
The System indicate the traffic event data on the screen in the Regional Main Center and the road management office.	
V	
The operator in the Regional Main Center checks the validity of the data and inputs the check flag for the data.	
V	
The operator inputs the data for generating the linkage and priority among the traffic events.	
V	
V	
V	
V	

Notes of reference for underlined words:
- Traffic event→ Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.9
- Road management office→ Figures 3.1, 3.4, 3.9
- Regional Main Center→ Figures 3.1, 3.4, 3.9

6.6.13 Traffic Event Management by Patrol Crew

Preconditions & Outline: When a traffic event occurs on the expressway, its data can be input by a patrol crew using a mobile input terminal and checked by the operators in the road management office and the Regional Main Center.

Event Steps:

A patrol crew inputs the category/class, date/time and location of a traffic event into the System by a mobile input terminal.	
V	
The System indicate the traffic event data on the screen in the Regional Main Center and the competent road management office.	
V	
The road operator in the road management office checks the traffic event data by the System.	
V	
The road operator inputs the detail data of the traffic event into the System.	
V	
The road operator checks the validity of the data and inputs the check flag for the data.	
V	
The operator in the Regional Main Center checks the validity of the data and inputs the check flag for the data.	
V	
V	
V	

Notes of reference for underlined words:
- Traffic event→ Table 6.2
- Road operator→ Figures 3.1, 3.4, 3.9
- Road management office→ Figures 3.1, 3.4, 3.9
- Regional Main Center→ Figures 3.1, 3.4, 3.9

6.6.14 Traffic Information Indication on VMS

Preconditions & Outline: Traffic information indication on VMS in case of a serious incident/event, which affects the expressway traffic in a wide area, is to be carried out from the Regional Main Center through system.

Event Steps:

An operator in the Regional Main Center recognizes a message candidate to be indicated on VMS shown by the System on a VMS monitor screen.	
V	
The operator checks traffic conditions and events on expressway network shown on the main monitor screen.	
V	
The operator selects (or inputs) the appropriate message for a VMS in each location.	
V	
The message is indicated on VMS.	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Traffic event→ Table 6.2
- VMS→ Figure 3.10
- Regional Main Center→ Figures 3.1, 3.4, 3.10, 6.8

6.6.15 Traffic Information by Internet

Preconditions & Outline: All data required for operating ITS are generated/stored in the System in other tasks of expressway operation in advance, and the data of traffic information for the Internet are to be generated automatically being picked out from them.

Event Steps:

The operator in the Regional Main Center recognizes a traffic event shown by the System on a traffic event monitor screen.	
V	
The operator put an acceptance check on the traffic event to be disseminated through the Internet.	
V	
The operator inputs the traffic event data into the System for dissemination.	
V	
The information is disseminated to the public through the Internet.	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Traffic event→ Table 6.2
- Internet→ Figure 3.11
- Regional Main Center→ Figures 3.1, 3.4, 3.11

6.6.16 Traffic Information by Broadcast

Preconditions & Outline: All data required for operating ITS are generated/stored in the System in other tasks of expressway operation in advance, and the data of traffic information for broadcast are to be generated automatically being picked out from them.

Event Steps:

The operator in the Regional Main Center recognizes a traffic event shown by the System on a traffic event monitor screen.	
V	
The operator put an acceptance check on the traffic event to be disseminated through TV/Radio Broadcasting.	
V	
The operator inputs the traffic event data into the System for dissemination.	
V	
The information is disseminated to the public through TV/Radio Broadcasting.	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Traffic event→Table 6.2
- Traffic information→ Figure 3.11
- TV/Radio Broadcasting center→ Figure 3.11
- Regional Main Center→ Figures 3.1, 3.4, 3.11

6.6.17 Traffic Information Cancellation

Preconditions & Outline: The data no longer required in ITS operation are updated/deleted in other tasks of expressway operation, and the data of traffic information for the Internet or broadcast are to be cancelled automatically reflecting them.

Event Steps:

The operator in the Regional Main Center receives information about the end of a traffic event through the System or telephone.	
V	
The operator in the Regional Main Center recognizes a traffic event shown by the System on a traffic event monitor screen.	
V	
The operator put a removal check on the traffic event to be disseminated through TV/Radio Broadcasting.	
V	
The operator saves traffic event data in the System.	
V	
The message on VMS is removed.	
V	
The information about the end of traffic event is disseminated to the public through the Internet.	
V	
The information about the end of traffic event is disseminated to the public through TV/Radio Broadcasting.	
V	
V	

Notes of reference for underlined words:
- Traffic event→Table 6.2
- Traffic information→ Figure 3.11
- Internet→ Figure 3.11
- TV/Radio Broadcasting center→ Figure 3.11
- Road management office→ Figures 3.1, 3.4, 3.10
- Regional Main Center→ Figures 3.1, 3.4, 3.10

6.6.18 Integrated Data Management

Preconditions & Outline: All data required for operating ITS are generated in the System in other tasks of expressway operation in advance and accumulated in the Data Integration Center.

Event Steps:

The road owner sends toll collection data and toll settlement data periodically to the Data Integration Center.	
V	
The System in the Data Integration Center is to acquire the traffic volume data and traffic event data automatically from the Regional Main Center.	
V	
The System in the Data Integration Center is to acquire the vehicle weighing data automatically from the toll offices through the Regional Main Center.	
V	
The System is to store the acquired data and generate the statistic data and print-out them in the forms of periodical/non-periodical documents.	
V	
The manager in the Regional Main Center is to utilize the data for inspection and budget plan of road improvement/maintenance.	
V	
The manager is to check validity of toll revenues of the road operators comparing the toll settlement data and the traffic volume data.	
V	
The manager is to utilize the data for making evaluation of road operator's achievement in the expressway operation.	
V	
V	

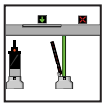
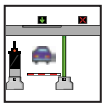
Notes of reference for underlined words:
- Traffic volume data→ Figure 3.19
- Traffic event data→ Table 6.2
- Vehicle weighing data→Figures 3.17, 3.19
- Toll collection data→Figures 3.11, 3.19
- Toll Settlement data→ Figures 3.12, 3.19
- Road owner→ Figure 3.19
- Road operator→ Figures 3.1, 3.4, 3.19
- Regional Main Center→ Figures 3.1, 3.4, 3.19

6.7 Toll Collection/Management

6.7.1 Toll Collection at Manual Lane

Preconditions & Outline: Toll collection is to be made by cash for a road user in the manual lane without IC-card and OBU for ETC.

Event Steps:

The road user stops vehicle at the tollgate.	
V	
The license number (and vehicle class) is identified, the license plate being captured.	
V	
The road user pays the toll to a collector by cash or a monthly ticket.	
V	
The collector at the tollgate inputs data for generating transaction data.	
V	
The tollgate barrier is opened when the transaction is completed.	
V	
The road user passes the tollgate.	
V	
All transaction data are stored in the System at roadside.	
V	
V	

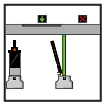
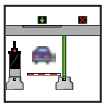
Notes of reference for underlined words:
- Toll collection→ Figure 6.9
- Tollgate→ Figure 6.9
- IC-card→ Figures 3.13, 3.14, 6.11
- OBU→ Figures 3.15, 6.12
- Transaction data→ Figure 6.10, Table 6.3

6.7.2 Toll Collection at Touch&Go Lane

Normal Case

Preconditions & Outline: Toll collection is to be made by using an IC-card with sufficient prepaid balance for a road user in the Touch&Go lane.

Event Steps:

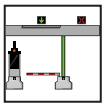
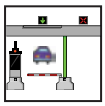
The road user stops vehicle at the tollgate.	
V	
The road user touches IC-card reader with IC-card.	
V	
The license number (and vehicle class) is identified, the license plate being captured.	
V	
Toll amount is deducted from prepaid balance in the IC-card.	
V	
The tollgate barrier is opened in the case toll collection is successfully completed.	
V	
The road user passes a tollgate.	
V	
All transaction data are stored in the System at roadside.	
V	
V	

Notes of reference for underlined words:
- Toll collection→ Figure 6.9
- Tollgate→ Figure 6.9
- Touch&Go → Figure 6.11
- IC-card→ Figures 3.13, 3.14, 6.11
- OBU→ Figures 3.15, 6.12
- Transaction data→ Figure 6.11, Table 6.3

Balance Shortage

Preconditions & Outline: Toll collection is intended to be made using an IC-card by a road user in the Touch& Go lane, but its prepaid balance is not sufficient and the collection is to be processed by cash.

Event Steps:

The road user stops vehicle at the tollgate.	
V	
The road user touches IC-card reader with IC-card.	
V	
The System at roadside identified a negative value of prepaid balance of the IC-card and toll due/paid sign indicates the error of balance shortage.	
V	
The tollgate barrier is not opened and the road user stops the vehicle.	
V	
A toll collector requires the road user to pay toll by manual.	
V	
The road user pays the toll to a collector by cash or a monthly ticket.	
V	
The collector at the tollgate inputs data for generating transaction data.	
V	
The road user passes the tollgate.	
V	
All transaction data are stored in the System at roadside.	

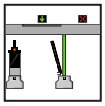
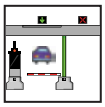
Notes of reference for underlined words:
- Toll collection→ Figure 6.9
- Tollgate→ Figure 6.9
- Touch&Go → Figure 6.11
- IC-card→ Figures 3.13, 3.14, 6.11
- OBU→ Figures 3.15, 6.12
- Transaction data→ Figure 6.11, Table 6.3

6.7.3 Toll Collection at ETC Lane

Normal Case

Preconditions & Outline: Toll collection is to be made by using an OBU and IC-card with sufficient prepaid balance for a road user in the ETC lane.

Event Steps:

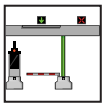
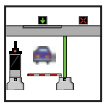
A road user drives vehicle approaching to a tollgate while slowing down.	
V	
The ETC roadside equipment obtains the information of IC-card and OBU.	
V	
The license number (and vehicle class) is identified, the license plate being captured.	
V	
Toll amount is deducted from prepaid balance in the IC-card.	
V	
The tollgate barrier is opened in the case toll collection is successfully completed (including the case prepaid balance is results in a negative value).	
V	
The road user can pass the tollgate without stopping.	
V	
The transaction data are stored in the System at roadside.	
V	
V	

Notes of reference for underlined words:
- Toll collection→ Figure 6.9
- Tollgate→ Figure 6.9
- ETC lane→ Figure 6.12
- IC-card→ Figures 3.13, 3.14, 6.12
- OBU→ Figures 3.15, 6.12
- Transaction data→ Figure 6.12, Table 6.3

Balance Shortage

Preconditions & Outline: Toll collection is intended to be made using an OBU and IC-card by a road user in the ETC lane, but its prepaid balance is not sufficient and the collection is to be processed by cash.

Event Steps:

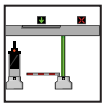
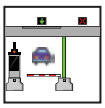
A road user drives vehicle approaching to a tollgate while slowing down.	
V	
The ETC roadside equipment obtains the information of IC-card and OBU.	
V	
The System at roadside identified a negative value of prepaid balance of the IC-card and toll due/paid sign indicates the error of balance shortage.	
V	
The tollgate barrier is not opened and the road user stops the vehicle.	
V	
A toll collector requires the road user to pay toll by manual.	
V	
The road user pays the toll to a collector by cash or a monthly ticket.	
V	
The collector at the tollgate inputs data for generating transaction data.	
V	
The road user passes the tollgate.	
V	
All transaction data are stored in the System at roadside.	

Notes of reference for underlined words:
- Toll collection→ Figure 6.9
- Tollgate→ Figure 6.9
- ETC lane→ Figure 6.12
- IC-card→ Figures 3.13, 3.14, 6.12
- OBU→ Figures 3.15, 6.12
- Transaction data→ Figure 6.12, Table 6.3

6.7.4 Handling of Vehicle without OBU in ETC Lane

Preconditions & Outline: Toll collection is intended to be made by cash by a road user in the ETC lane without IC-card and OBU for ETC and the collection is to be processed by cash.

Event Steps:

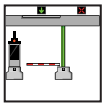
A road user drives vehicle approaching to a tollgate while slowing down.	
V	
The System at roadside identified vehicle without OBU is going to pass the ETC lane.	
V	
The tollgate barrier is not opened and the road user stops the vehicle.	
V	
A toll collector requires the road user to pay toll by manual.	
V	
The road user pays the toll to a collector by cash or a monthly ticket.	
V	
The collector at the tollgate inputs data for generating transaction data.	
V	
The road user passes the tollgate.	
V	
All transaction data are stored in the System at roadside.	
V	

Notes of reference for underlined words:
- Toll collection→ Figure 6.9
- Tollgate→ Figure 6.9
- ETC lane→ Figure 6.12
- IC-card→ Figures 3.13, 3.14, 6.12
- OBU→ Figures 3.15, 6.12
- Transaction data→ Figure 6.12, Table 6.3

6.7.5 Handling of OBU Re-installed Illegally

Preconditions & Outline: Toll collection is intended to be made using an OBU and IC-card by a road user in the ETC lane, but OBU has been re-installed illegally and the vehicle is to be rejected.

Event Steps:

A road user drives vehicle approaching to a tollgate while slowing down.	
V	
The ETC roadside equipment obtains the information in OBU.	
V	
The System indicates OBU information on screen for the toll collector.	
V	
The toll collector identifies vehicle with wrong information in OBU.	
V	
The toll collector shut the tollgate barrier.	
V	
The toll collector inputs toll collection data for OBU invalidation in the System.	
V	
The toll collector reject the vehicle to the toll office.	
V	
V	

Notes of reference for underlined words:
- Tollgate→ Figure 6.9
- ETC lane→ Figure 6.12
- IC-card→ Figures 3.13, 3.14, 6.12
- OBU→ Figures 3.15, 6.13
- OBU invalidation→ Figures 3.15, 6.13
- Toll collection data→ Figure 6.13, Table 6.3

6.7.6 Tollgate Lane Monitoring by Camera

Preconditions & Outline: Movement of the vehicles and situations of the tollgate are to be captured by cameras in order to perform toll collection without any falseness/dishonesty.

Event Steps:		
	A road user drives vehicle approaching to a tollgate while slowing down.	
	V	
	Movement of the vehicle is captured by a camera in the tollgate lane.	
	V	
	A collector checks suspicious movement of the vehicle by captured video image through a monitor in the tollgate lane.	
	V	
	Overall picture of the tollgate is captured by another camera installed on high.	
	V	
	An operator checks situations in the tollgate by captured video image through a monitor in the toll office.	
	V	
	V	
	V	
	V	

Notes of reference for underlined words:
- Tollgate→ Figures 6.9

6.7.7 Toll Data Management

Precondition s& Outline: The transaction data is to be processed into the toll collection data and to be checked in the toll office, then the data is to be processed into the settlement data and checked in the road owner's head office.

Event Steps:

The System in the toll office is to acquire the transaction data automatically from tollgate lanes.	
V	
The System is to generate the toll collection data daily.	
V	
The operator in the toll office is to check the transaction data and toll collection data.	
V	
The System in the road owner's head office is to acquire the toll collection data automatically from the toll offices of its own expressways.	
V	
The System is to generate/print-out the toll settlement data monthly.	
V	
The road owner is to check the toll settlement data.	
V	
V	
V	

Notes of reference for underlined words:
- Toll settlement→ Figure 3.13
- Transaction data→ Figures 6.10, 6.11, 6.12, Table 6.3
- Toll collection data→ Figures 3.12, 6.14, Table 6.3
- Bank→ Figures 3.12, 3.13
- Road owner→ Figure 3.12

6.7.8 Toll Settlement

Preconditions & Outline: Toll settlement is to be performed exchanging data between the Systems of the toll office and a bank.

Event Steps:

The road owner claims toll fare sending the settlement data to a bank.	
V	
The System in the bank is to generate the toll payment data based on the toll settlement data.	
V	
The bank staff is to check the toll settlement data and the toll payment data.	
V	
The bank is to transfer the toll payment of charged amount to the road owner.	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Toll settlement→ Figure 3.13
- Toll collection data→ Figures 3.12, 6.14, Table 6.3
- Traffic data→ Figure 3.19
- Road owner→ Figure 3.12
- Bank→ Figures 3.12, 3.13
- Regional Main Center→ Figure 3.19
- Toll Office →Figure3.12

6.7.9 IC-card Management

Issuance

Preconditions & Outline: Issuance/management of the IC-card is to be executed by the bank for the road user.

Event Steps:

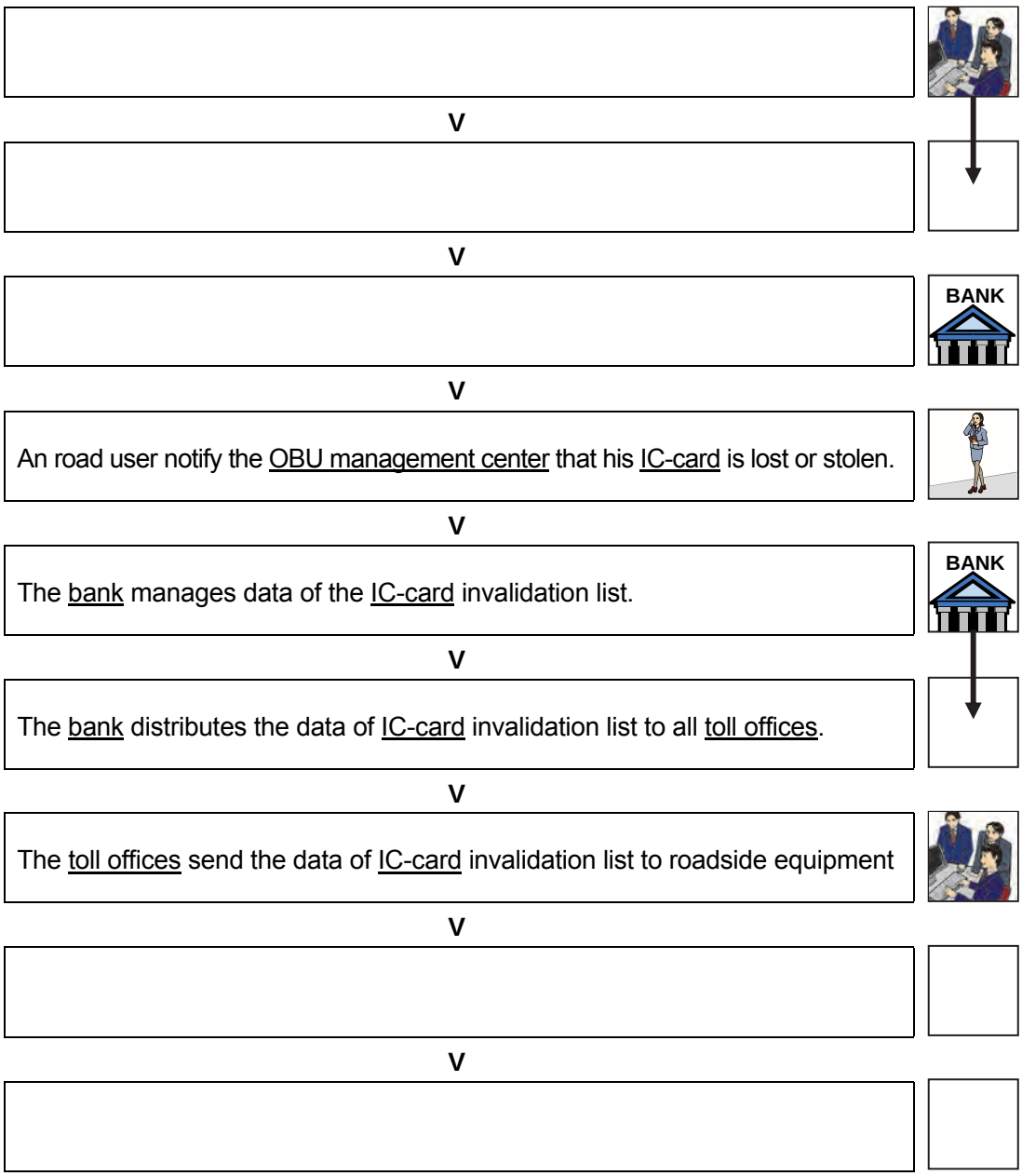
A road user applies for IC-card issue in a bank.	
V	
A staff of the bank inputs the road user data into the System.	
V	
The bank issues IC-card to the road user.	
V	
The data for IC-card issuance is generated in the System.	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- IC-card→ Figures 3.13, 3.14
- Bank→ Figures 3.12, 3.13

Invalidation

Preconditions & Outline: IC-card invalidation is to be processed by the bank, when the loss of an IC-card is notified from the user.

Event Steps:



Notes of reference for underlined words:
- IC-card→ Figures 3.13, 3.14, 6.13
- Bank→ Figures 3.12, 3.13, 6.13
- OBU management center→ Figures 3.15, 6.13
- Toll office → Figures 3.14, 3.15, 6.13

6.7.10 Top-up of Prepaid Balance

Preconditions & Outline: Top-up of prepaid balance of the IC-card is to be processed by the bank receiving the deposit from the user.

Event Steps:		
	A road user goes to a bank for recharging the prepaid balance.	
	V	
	The road user inserts the IC-card in the terminal of the bank.	
	V	
	The road user makes payment for top-up of the prepaid balance.	
	V	
	The road user receives the IC-card with top-up.	
	V	
	V	
	V	
	V	
	V	

Notes of reference for underlined words:
- IC-card→ Figures 3.14, 6.11, 6.12
- Bank→ Figures 3.13, 3.14

6.7.11 OBU Management

Registration

Preconditions & Outline: Registration/management of the OBU is to be executed by the OBU management center for the road user.

Event Steps:

A road user applies for the OBU use to the OBU management center.	
∨	
The operator in the OBU management center inputs the registration data of road user with OBU registration terminal.	
∨	
The operator in the OBU management center issues the OBU to the road user.	
∨	
The OBU registration data in the OBU registration terminal are sent to the OBU management server.	
∨	
The OBU management server transfers the OBU registration data to the road owners.	
∨	
The road user installs OBU in his vehicle and puts IC-card into OBU.	
∨	
The road user can pass the ETC lane.	
∨	
∨	

Notes of reference for underlined words:
- IC-card→ Figures 3.14, 6.11, 6.12
- OBU→ Figures 3.15, 6.12
- OBU registration→ Figure 3.15, 6.13
- OBU management center→ Figures 3.15, 6.13
- Road owner→ Figures 3.14, 3.15, 6.13

Invalidation

Preconditions & Outline: OBU invalidation is to be processed by the OBU management center, when the loss of an OBU is notified from the user..

Event Steps:

A road owner picks up data of the vehicle which OBU is replaced from the transaction data at the tollgate.	
V	
The road owner sends the data of replaced OBU to the OBU management Canter.	
V	
The OBU management center manages data of the OBU invalidation list.	
V	
A road user notifies the OBU management center that his OBU is lost or stolen.	
V	
The operator in the OBU management center inputs information into the OBU invalidation list.	
V	
The OBU management center manages data of the OBU invalidation list.	
V	
The OBU management center distributes the data of OBU invalidation list to all road Owners.	
V	
The road owners send the data of OBU invalidation list to roadside equipment of all toll offices.	
V	

Notes of reference for underlined words:
- OBU→ Figures 3.15, 6.12, 6.13
- Transaction Data→ Figure 6.13
- OBU invalidation→ Figure 3.15, 6.13
- OBU management center→ Figures 3.15, 6.13
- Road owner→ Figures 3.15, 6.13

6.7.12 Toll Enforcement Assistance

Preconditions & Outline: Toll enforcement is to be executed by the police based on the legal basis prepared for controlling unlawful drivers who ignore payment of toll.

Event Steps:

A road owner picks up data of the IC-card which prepaid balance is repeatedly negative value from the transaction data at the tollgate.	
V	
The road owner identifies the IC-card user of suspicion getting documents from the OBU management center.	
V	
The road owner picks up data of the vehicle which OBU is replaced from the transaction data at the tollgate.	
V	
The road owner identifies the OBU user of suspicion getting information from the bank.	
V	
The road owner complains the users of suspicion to the police office based on the evidence which includes data and documents.	
V	
The police enforce a legal system.	
V	
V	
V	

Notes of reference for underlined words:
- IC-card→ Figures 3.14, 6.13
- OBU→ Figures 3.15, 6.12, 6.13
- Transaction Data→ Figure 6.13
- Road owner→ Figure 3.15, 6.13
- OBU management center→ Figures 3.15, 3.16

6.8 Vehicle Weighing

6.8.1 Axle Load Measurement

Normal Case

Preconditions & Outline: A heavy truck driver is to be allowed to pass an entrance tollgate by the traffic inspector in the case measured truck weight is beyond the defined limit value.

Event Steps:

The crew of tollgate identifies a heavy truck approaching to the entrance tollgate.	
V	
The crew is to lead the truck to a measurement lane.	
V	
The truck is to pass an axle load scale in the lane.	
V	
The axle load scale is to measure/indicate the weight of the truck for being checked by an operator on site.	
V	
The traffic inspector is to allow the heavy truck to pass the tollgate in the case the indicated weight is within the defined limit value.	
V	
The lane server is to send the measured weight and captured image of license plate of the heavy truck to the System in the toll office.	
V	
V	
V	

Notes of reference for underlined words:
- Traffic inspector→ Figure 3.17
- Road operator→ Figures 3.1, 3.17

Penalty for Overloading

Preconditions & Outline: A heavy truck driver is to be inflicted a penalty at an entrance tollgate by the traffic inspector in the case measured truck weight is beyond the defined limit value.

Event Steps:

The crew of tollgate identifies a heavy truck approaching to the entrance tollgate.	
V	
The crew is to lead the truck to a measurement lane.	
V	
The truck is to pass an axle load scale in the lane.	
V	
The axle load scale is to measure/indicate the weight of the truck for being checked by an traffic inspector on site.	
V	
The traffic inspector is to collect a penalty from the truck driver in the case the indicated weight is beyond the defined limit value.	
V	
The lane server is to send the measured weight and captured image of license plate of the heavy truck to the System in the toll office.	
V	
V	
V	

Notes of reference for underlined words:
- Traffic inspector→ Figure 3.17
- Road operator→ Figures 3.1, 3.17

6.8.2 Measurement Lane Monitoring by Camera

Preconditions & Outline: Movement of the vehicles is to be captured by camera in order to perform vehicle weighing without any falseness/dishonesty.

Event Steps:

A heavy truck approaches to the entrance tollgate to pass an axle load scale.	
V	
Movement of the vehicle is captured by a camera in the measurement lane.	
V	
A traffic inspector checks suspicious movement of the vehicle by captured video image through a monitor in the toll office.	
V	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Tollgate→ Figures 6.9
- Traffic inspector→ Figure 3.17

6.8.3 Axle Load Data Management

Preconditions & Outline: The data of measured axle loads and captured license plates of heavy trucks are to be accumulated in the System in the toll office and to be sent to the Regional Main Center.

Event Steps:

The measured axle loads and captured license plates of heavy trucks are to be stored as the vehicle weighing data in the System in the toll office.	
V	
The measured axle loads are to be compared with the acceptable value of weight.	
V	
In case the measured axle loads are out of range, the data are to be judged/ stored as the violation information.	
V	
The traffic inspector is to check the violation information.	
V	
The System is to send data automatically to the Regional Main Center.	
V	
V	
V	
V	

Notes of reference for underlined words:
- Traffic inspector→ Figure 3.17
- Regional Main Center→ Figures 3.1, 3.17, 3.18

6.8.4 Overloading Regulation by Post-treatment

Preconditions & Outline: The data for overloading regulation are to be acquired/stored in the Regional Main Center and the regulation is to be made by post-treatment.

Event Steps:

The vehicle weighing data and violence information are to be acquired/stored in the System in the Regional Main Center.	
V	
The operator in the Regional Main Center is to check details of the violation user information.	
V	
The operator is to report the violation user information to the road management office, the road owner and the expressway police.	
V	
V	
V	
V	
V	
V	

Notes of reference for underlined words:
- Expressway police→ Figure 3.17
- Road owner→ Figure 3.17
- Road management office→ Figures 3.1, 3.17
- Regional Main Center→ Figures 3.1, 3.17, 3.18

7. Procedures of System Operation/Management

7.1 General

In this chapter, Operating Procedures required for actualizing ITS are to be picked out from the Sequence Diagrams prepared for the Implementation Packages and the following items are to be clarified focusing on the operating procedures:

- Processing/Screen Transition Diagram
- Major Message List
- Primary Data Dictionary.

For picking out the Operating Procedures, the major equipment components is to be assumed respectively for the Functional Packages as shown in the table below.

Table 7.1 Major Equipment Components of Functional Package

Functional Packages		Major Equipment Component	
1.Traffic Information/ Control System	(1) Voice Communication	Call Controller (RMC)	1-1-a
		Call Controller (RMO)	1-2-a
	(2) CCTV Monitoring	CCTV Control/Monitoring Console (RMC)	1-3-a
		CCTV Control/Monitoring Console (RMO)	1-4-a
	(3) Event Detection (by Image)	Image Recognition Processor (RMO)	1-5-a
	(4) Vehicle Detection	Traffic Data Server (RMC)	1-6-a,b
	(5) Traffic Analysis	Traffic Data Server (RMC)	
	(6) Weather Monitoring	Weather Data Server (RMC)	1-7-a,b
	(7) Traffic Event Data Management	Traffic Event Data Server (RMC)	1-8-a,,e
		Traffic Event Data Server (RMO)	1-9-a,b
	(8) Traffic Supervision	Traffic Supervising/Control Server (RMC)	1-10-a,b
		Traffic Event Data Server (RMO)	1-11-a,b
	(9) VMS Indication	VMS Center Controller (RMC)	1-12-a,,c
		VMS Controller (RMO)	1-13-a,,c
	(10) Mobile Radio Communication	Radio Comm. Controller (RMO)	1-14-a
	(11) Traffic Information	Traffic Information Server (RMC)	1-15-a
	(12) Integrated Data Management	Integrated Data Server (VEA)	1-16-a
2.Toll Collection/ Management System	(13) Tollgate Lane Monitoring	CCTV Monitoring Console (TO)	2-1-a,b
	(14) Vehicle/Class Identification	Lane Server (TO)	2-2-a,,g
	(15) Lane Control	Lane Server (TO)	
	(16) Road-to-Vehicle Communication	Roadside Controller (Roadside)	2-3-a,b
		OBU (In-vehicle)	2-4-a
	(17) IC-card Recording	IC-card R/W (Roadside)	2-5-a,b
	(18) Toll Data Management	Toll Management Server (TO)	2-6-a,,c
		Toll Management Center Server (TMC)	2-7-a,,d
	(19) OBU Management	OBU Management Server (OMC)	2-8-a,,c
3.VehicleWeighing System	(20) Axle Load Measurement	Heavy Truck Control Data Server (ET)	3-1-a,,c
	(21) Measurement Lane Monitoring	CCTV Monitoring Console (ET)	3-2-a

Note, RMC: Regional Main center, RMO: Road Management Office, VEA: Expressway Management Agency, TO: Toll Office, TMC: Toll Management Center, OMC: OBU Management Center, ET: Entrance Tollgate.
Greyed out area is "For Reference".

(1) Northern Regional Main Center

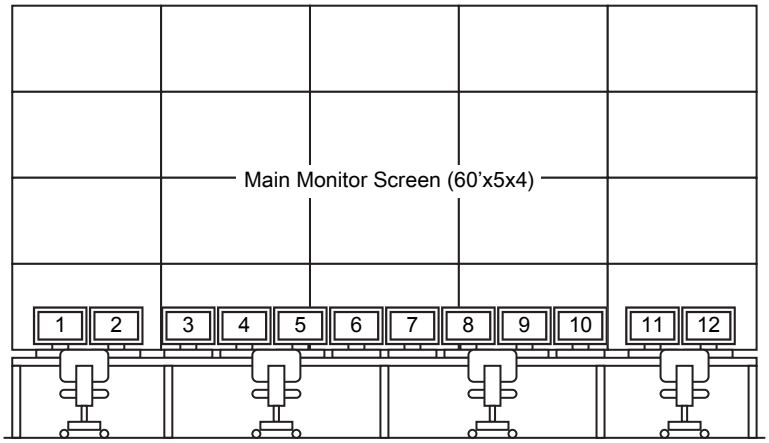
Traffic information/control is to be conducted totally from the Regional Main Center using the following Functional Packages:

- Voice communication
- CCTV monitoring

- Event detection (by Image)
- Vehicle detection
- Traffic analysis
- Weather monitoring
- Traffic event data management
- Traffic supervision
- VMS indication
- Traffic information.

For actualising the functions aforementioned, pieces of the center equipment are to be installed in the Regional Main Center as shown in the figure below. The data from vehicle detectors and weather sensors are to be processed in the Regional Main Center, and VMSs and CCTV cameras are to be controlled directly from the Regional Main Center as well as the road management office for integrating traffic information dissemination.

Figure 7.1 Equipment Overview in Regional Main Center



1. Traffic Data Monitor/Input Device
2. Weather Data Monitor/input Device
3. Directive Telephone Console
4. CCTV Control/Monitoring Console
5. Traffic Event Data Console
6. Traffic Supervising/Control Console
7. Directive Telephone Console
8. CCTV Control/Monitoring Console
9. Traffic Event Data Console
10. Traffic Supervising/Control Console
11. VMS Center Controller Monitor/Input Device
12. Traffic Information Monitor/Input Device

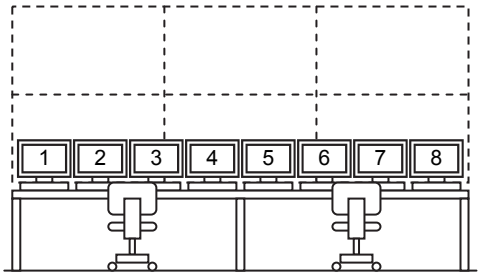
Source: The Study Team

(2) Road Management Office

A part of center equipment is to be installed in the road management offices for expressway operation. CCTV cameras are to be controlled and the traffic event data are to be input from the road management office as well for handling and clearing incidents. The traffic event data is to be input from the road management office; however, prioritisation of the traffic event data is to be done in the Regional Main Center and guidance based on it is to be sent to the operators in road management offices for to input the data to be indicated by VMS/CSS.

- Voice communication
- Mobile radio communication
- CCTV monitoring
- Traffic event data management
- VMS indication.

Figure 7.2 Equipment Overview in Road Management Office



1. Mobile Communication Control Console
2. CCTV Control/Monitoring Console
3. Traffic Event Data Console
4. VMS Controller Monitor/Input Device
5. Mobile Communication Control Console
6. CCTV Control/Monitoring Console
7. Traffic Event Data Console
8. VMS Controller Monitor/Input Device

Note: Main monitor screen can be omitted if it is not necessary in the road management office.

Source: The Study Team

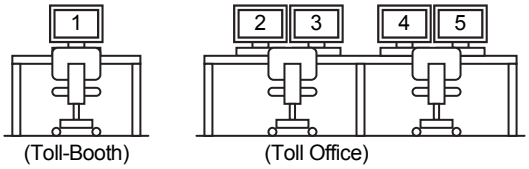
(3) Toll Office

Major functions of Vehicle Weighting are to be installed in the toll offices which are to be located at respective tollgates aiming to integrate toll-booths:

- Lane control (*)
- Vehicle/class identification (*)
- Road-to-vehicle communication (*)
- IC-card recording (*)
- Toll data management (*)
- Tollgate lane monitoring (*)
- Axle load measurement (*)
- Measurement lane monitoring (*).

(*): (For Reference)

Figure 7.3 Equipment Overview in Toll-Booth and Toll Office



1. Toll Data Input Console (*)
2. Toll Management Monitor/Input Device (*)
3. CCTV Monitoring Console (*)
4. Heavy Truck Control Data Server Monitor/Input Device (*)
5. CCTV Monitoring Console (*).

(*): For Reference
Source: The Study Team

(4) Data Integration Center

The integrated data server is to be installed in the Data Integration Center for actualizing its function. The data are to be acquired from the data servers in the Regional Main Center and the toll offices, and to be managed by the operator.

7.2 Operating Procedures shown in System Architecture

The Operating Procedures required for expressway operation using ITS are to be specified in the following table in reference to the Functional Packages and the Element Tasks. The titles of Operating Procedures including “initialization” are defined for the initialization which can be executed more than once for stepwise system implementation or efficient system operation, but excluding initialization of hardware.

Table 7.2 List of Operating Procedures for ITS

1. Traffic Information/Control System	Corresponding Functional Packages / Element Tasks
1-1 Call Controller (RMC)	**→ (1) Voice Communication**
1-1-a Directive Call Control Displaying and processing in series processing in series for issuing the necessary instructions for traffic control from the RMC to the selected RMOs/Departments in charge or to all relevant entities at once, and for exchanging the necessary information.	→ Element Tasks 6.6.1, 6.6.2, 6.6.3, 6.6.4, 6.6.5, 6.6.7, 6.6.8, 6.6.9, 6.6.11, 6.6.12 and 6.6.13
1-2 Call Controller (RMO)	**→ (1) Voice Communication**
1-2-a Directive Call Control Displaying and processing in series for selecting the Departments in charge in the responsible RMO, and for exchanging spoken information with them.	→ Element Tasks 6.6.7 and 6.6.10
1-3 CCTV Control/Monitoring Console (RMC)	**→ (2) CCTV Monitoring**
1-3-a Camera/Video Control Displaying and a series of processing for selecting the CCTV Cameras to display the live/recorded images from the cameras on the CCTV Control/Monitoring Consoles or the Main Monitor Screen, and for controlling the CCTV Cameras as necessary.	→ Element Tasks 6.6.2, 6.6.3, 6.6.4, 6.6.5, 6.6.8 and 6.6.9
1-4 CCTV Control/Monitoring Console (RMO)	**→ (2) CCTV Monitoring**
1-4-a Camera/Video Control Displaying and processing in series for selecting the CCTV Cameras to display the live/recorded images from the cameras on the CCTV Control/Monitoring Consoles or the Main Monitor Screen, and for controlling the CCTV Cameras as necessary.	→ Element Tasks 6.6.2, 6.6.3, 6.6.4, 6.6.5, 6.6.8 and 6.6.9
1-5 Image Recognition Processor (RMO)	**→ (3) Event Detection (by Image)**
1-5-a Initialization for Event Detection Displaying and processing in series for inputting the initial data, such as the lists of available detectors and subject traffic events, required for the event detection.	→ Element Task 6.6.2
1-6 Traffic Data Server (RMC)	**→ (4) Vehicle Detection, (5) Traffic Analysis**
1-6-a Initialization for Empirical Traffic Analysis Displaying and processing in series for inputting the initial data, such as the lists of available detectors and parameters, required for traffic analysis using the empirical method proven effective for expressway networks.	→ Element Task 6.6.6
1-6-b Empirical Traffic Analysis Data Check Displaying and processing in series for showing a list of values measured by Vehicle Detectors, time dependent change in the measured values and the results of traffic analysis based on the measured values, and for printing the results.	
1-7 Weather Data Server (RMC)	**→ (6) Weather Monitoring**
1-7-a Initialization for Empirical Bad Weather Identification Displaying and processing in series for inputting the initial data, such as the list of available Weather Sensors and the threshold values for categorizing bad weather,	→ Element Task 6.6.3

required for bad weather identification using the empirical method proven effective for expressway networks.	
1-7-b Empirical Bad Weather Identification Data Check Displaying and processing in series for showing a list of the values measured by Weather Sensors, time dependent change in the values measured by a sensor and for printing the results.	
1-8 Traffic Event Data Server (RMC)	**→ (7) Traffic Event Data Management**
1-8-a Initialization for Empirical Traffic Event Definitization Displaying and processing in series for inputting the initial data such as the lists of roads, IC parameters and roadside equipment, required for registering and definitizing the traffic events using the empirical method proven effective for expressway networks.	→ Element Tasks 6.6.1, 6.6.2, 6.6.3, 6.6.4, 6.6.5, 6.6.6, 6.6.7, 6.6.8, 6.6.9, 6.6.11, 6.6.12, 6.6.13, 6.6.14, 6.6.15, 6.6.16, 6.6.17 and 6.6.18
1-8-b Empirical Traffic Event Definitization/Listing Displaying and processing in series for registering candidate types of the traffic events identified by CCTV Cameras or telephone calls, for showing a list of candidate types of traffic events including traffic accidents, congestion and bad weather detected by detectors and sensors and the CCTV Camera IDs nearest to the traffic event sites, for definitizing and correlate the traffic event, and for making periodical checks of the traffic events, all using the empirical method proven effective for expressway networks.	
1-8-c Empirical Traffic Event Prioritization Displaying and processing in series for prioritizing the information based on the locations and types of the traffic events, using the empirical method proven effective for expressway networks.	
1-8-d Tabulation/Printout of Traffic Event Displaying and processing in series for printing a list of traffic events, data of the designated traffic events and a summary table of traffic events occurred during a specific time period.	
1-8-e Traffic Event Data Exchange Displaying and processing in series for sending a list of traffic events to the police and the ambulance services and for receiving the relevant information from them.	
1-9 Traffic Event Data Server (RMO)	**→ (7) Traffic Event Data Management**
1-9-a Initialization for Empirical Traffic Event Registration Displaying and processing in series for inputting the initial data, such as the lists of roads, IC parameters and roadside equipment, required for registering using the empirical method proven effective for expressway networks.	→ Element Tasks 6.6.1, 6.6.2, 6.6.3, 6.6.4, 6.6.5, 6.6.7, 6.6.8, 6.6.9, 6.6.10, 6.6.11, 6.6.12 and 6.6.13
1-9-b Empirical Traffic Event Registration/Listing Displaying and processing in series for registering candidate types of the traffic events identified by CCTV Cameras or telephone calls, for showing a list of candidate types of traffic events including traffic accidents, congestion and bad weather detected by	

detectors and sensors, for pick-up showing a list of candidate types of traffic events relevant to the subject RMO and CCTV Camera IDs nearest to the traffic event sites, and for making periodical checks of traffic events, all using the empirical method proven effective for expressway networks.	
1-10 Traffic Supervising/Control Server (RMC)	**→ (8) Traffic Supervision**
1-10-a Main Monitor Initialization Displaying and processing in series for inputting the initial data required for showing images on the Main Monitor Screen and for switching the images to the images from multiple CCTV Cameras displayed on the side screens.	→ Element Tasks 6.6.8 and 6.6.9
1-10-b Mirroring onto Main Monitor Displaying and processing in series for showing, on the Main Monitor Screen, the images of the ID-designated CCTV Cameras, the screen of the Traffic Event Console, and the information to be displayed on VMS.	
1-11 Traffic Event Data Server (RMO)	**→ (8) Traffic Supervision**
1-11-a Main Monitor Initialization Displaying and processing in series for inputting the initial data required for switching displays on the Main Monitor Screen.	→ Element Tasks 6.6.8, 6.6.9 and 6.6.10
1-11-b Mirroring onto Main Monitor Displaying and processing in series for showing, on the Main Monitor Screen, the designated Traffic Event Data Console screen and the information to be displayed on VMS.	
1-12 VMS Center Controller (RMC)	**→ (9) VMS Indication**
1-12-a Initialization for VMS/CSS Indication Displaying and processing in series for showing the optimum information on all of VMSs using the empirical method proven effective for expressway networks, and for inputting the initial data required for controlling CSS displays.	→ Element Task 6.6.12
1-12-b Empirical VMS Texts Generation/Check Displaying and processing in series for showing on each VMS the necessary information as the guidance, upon receiving direct input of the optimum information generated as the results of prioritization of information on the traffic events using the empirical method proven effective for expressway networks.	
1-12-c CSS Indication/Check Displaying and processing in series for confirming/recognizing the speed to be displayed as allocated to each CSS and to display it on CSS, corresponding to the confirmed traffic events.	
1-13 VMS Controller (RMO)	**→ (9) VMS Indication**
1-13-a Initialization for VMS/CSS Indication Displaying and processing in series for inputting the initial data required to control the	→ Element Task 6.6.1

displays on VMS and CSS under its control.	
1-13-b VMS Guidance Check/Input Displaying and processing in series for showing the information on VMS upon receiving direct input of data corresponding to the displayed guidance.	
1-13-c CSS Indication/Check Displaying and processing in series for confirming/recognizing the speed to be displayed as allocated to each CSS and to display it on CSS, corresponding to the confirmed traffic events.	
1-14 Radio Communication Controller (RMO)	**→ (10) Mobile Radio Communication**
1-14-a Radio Communication Control Displaying and processing in series for issuing the necessary instructions to the patrol teams, Departments and Sections of RMO involved in the management duties to be implemented or to all related parties at once, and for exchanging the necessary information.	→ Element Tasks 6.6.2, 6.6.3, 6.6.4, 6.6.7, 6.6.8, 6.6.9, 6.6.10 and 6.6.13
1-15 Traffic Information Server (RMC)	**→ (11) Traffic Information**
1-15-a Traffic Information Generation/Update Displaying and processing in series for generating, based on the data received from the Traffic Event Data Server, the traffic information to be distributed to the relevant parties via internet, and for confirming, printing and publicizing the results.	→ Element Tasks 6.6.15, 6.6.16 and 6.6.17
1-16 Integrated Data Server (VEA)	**→ (12) Integrated Data Management**
1-16-a Integrated Data Generation/Update Displaying and processing in series for editing, confirming and printing the ITS-related data to be integrally saved and managed by MOT.	→ Element Task 6.6.18

2. Toll Collection/Management System (For Reference)	**Corresponding Functional Packages / Element Tasks**
2-1 CCTV Monitoring Console (TO)	**→ (13) Tollgate Lane Monitoring**
2-1-a Tollgate Lane Monitoring Displaying and processing in series for confirming, by CCTV Cameras, the conditions of vehicle passages and toll collecting activities at each tollgate lane.	→ Element Tasks 6.7.1, 6.7.2, 6.7.3, 6.7.4, 6.7.5 and 6.7.6
2-1-b Video Record Check Displaying and processing in series for checking monthly the recorded images to find the unlawful passage vehicles and for printing the documents for submission to the police.	
2-2 Lane Server (TO)	**→14) Vehicle/Class Identification, (15) Lane Control**
2-2-a Initialization for Lane Control Displaying and processing in series for inputting the initial data required for lane control, vehicle class identification and toll calculation at each tollgate lane.	→ Element Tasks 6.7.1, 6.7.2, 6.7.3, 6.7.4, 6.7.5 and 6.7.12
2-2-b Manual Procedure for Entrance	

Displaying and processing in series for conducting manual toll collection at the entry tollgate and for indicating any key data and errors to the tollgate personnel.	
2-2-c Manual Procedure for Exit/Flat-tariff Displaying and processing in series for conducting manual toll collection at the exit or flat-tariff tollgate and for indicating any key data and errors to the tollgate personnel.	
2-2-d Touch & Go Procedure for Entrance Displaying and processing in series for conducting toll collection by Touch&go at the entry tollgate and for indicating any key data and errors to the tollgate personnel.	
2-2-e Touch & Go Procedure for Exit/Flat-tariff Displaying and processing in series for conducting toll collection by Touch&go at the exit or flat-tariff tollgate and for indicating any key data and errors to the tollgate personnel.	
2-2-f ETC Procedure for Entrance Displaying and processing in series for conducting toll collection by ETC at the entry tollgate and for indicating any key data and errors to the tollgate personnel.	
2-2-g ETC Procedure for Exit/Flat-tariff Displaying and processing in series for conducting toll collection by ETC at the exit or flat-tariff tollgate and for indicating any key data and errors to the tollgate personnel.	
2-3 Roadside Controller (Roadside)	**→ (16) Road-to-Vehicle Communication**
2-3-a Road-to-Vehicle Communication Check for Entrance Displaying for conducting road-to-vehicle communication for ETC at the entry tollgate and for indicating any errors.	→ Element Tasks 6.7.3, 6.7.4 and 6.7.5
2-3-b Road-to-Vehicle Communication Check for Exit/Flat-tariff Displaying for conducting road-to-vehicle communication for ETC at the exit or flat-tariff tollgate and for indicating any errors.	
2-4 OBU (In-vehicle)	**→ (16) Road-to-Vehicle Communication**
2-4-a Road-to-Vehicle Communication Check by OBU Displaying for conducting road-to-vehicle communication for ETC and indicating any errors on OBU.	→ Element Tasks 6.7.2 and 6.7.3
2-5 IC-card R/W (Roadside)	**→ (17) IC-card Recording**
2-5-a IC-card R/W Check for Entrance Displaying for reading/writing IC-cards at the entry tollgate and for indicating any errors.	→ Element Tasks 6.7.2 and 6.7.3
2-5-b IC-card R/W Check for Exit/Flat-tariff Displaying for reading/writing IC-cards at the exit or flat-tariff tollgate and for indicating any errors.	
2-6 Toll Management Server (TO)	**→ (18) Toll Data Management**
2-6-a Initialization for Toll Management Displaying and processing in series for inputting the initial data required for toll management at TO, such as parameters of the tollgate lanes and lists of roadside	→ Element Task 6.7.7

equipment arrangement, and for receiving and saving the toll rate table updated at TMC and distributing it to each toll booth.	
2-6-b Daily Routine Processing Displaying and processing in series for updating the lists of IC-card invalidation and OBU invalidation and for collecting and saving the results of data exchange for toll collection at each toll booth.	
2-6-c Daily/Monthly Check Displaying and processing in series for creating the lists of results of toll collection at each toll booth and sending it to TMC, and for creating documents on unlawful passage vehicles to be submitted to the police.	
2-7 Toll Management Center Server (TMC)	**→ (18) Toll Data Management**
2-7-a Initialization for TMC Displaying and processing in series for inputting the initial data required for toll management at TMC, such as vehicle category and lists of TOs under its control, and for updating the toll rate table and distributing it to each TO.	→ Element Tasks 6.7.7, 6.7.8, 6.7.9, 6.7.11 and 6.7.11
2-7-b Monthly/Annual Total of Toll Displaying and processing in series for summarizing the monthly/annual toll revenues of all TOs and for sending it to the Data Integration Center.	
2-6-d IC-card Invalidation Listing Displaying and processing in series for updating, at an interval every day, the list of IC-card issuance/invalidation received from the bank, and for distributing them to each roadside.	
2-6-e OBU Invalidation Listing Displaying and processing in series for updating, at an interval every day, the list of OBU invalidation received from the OBU Management Center, and for distributing them to each roadside.	
2-8 OBU Management Server (OMC)	**→ (19) OBU Management**
2-8-a Initialization for OBU Management Displaying and processing in series for inputting the initial data required for managing OBUs, such as lists of the OBU Registration Terminals.	→ Element Task 6.7.11
2-8-b OBU Registration Displaying and processing in series for registering or invalidating OBUs and for updating the lists of OBU registration.	
2-8-c OBU Invalidation Displaying and processing in series for invalidating OBUs and for updating the lists of OBU invalidation.	

3. Heavy Truck Control System (For Reference)	Corresponding Functional Packages / Element Tasks
3-1 Heavy Truck Control Data Server (TO)	**→ (20) Axle Load Measurement**
3-1-a Initialization for Axle Load Measurement Displaying and processing in series for inputting the initial data required for axle load measurement and its management, such as the list of roadside equipment installed at TO and the threshold value for axle load management.	→ Element Tasks 6.8.1, 6.8.3 and 6.8.4
3-1-b Axle Load Measurement Displaying and processing in series for measuring the axle loads of a vehicle and for recording them with the licence number.	
3-1-c Axle Load Listing Displaying and processing in series for creating a list of the axle load measurement results.	
3-2 CCTV Monitoring Console (TO)	**→ (21) Measurement Lane Monitoring**
3-2-a Measurement Lane Monitoring Displaying and processing in series for confirming, by CCTV Cameras, the conditions of vehicle passages and the axle load measurement activities at each axle load measurement lane.	→ Element Task 6.8.2

Source: The Study Team

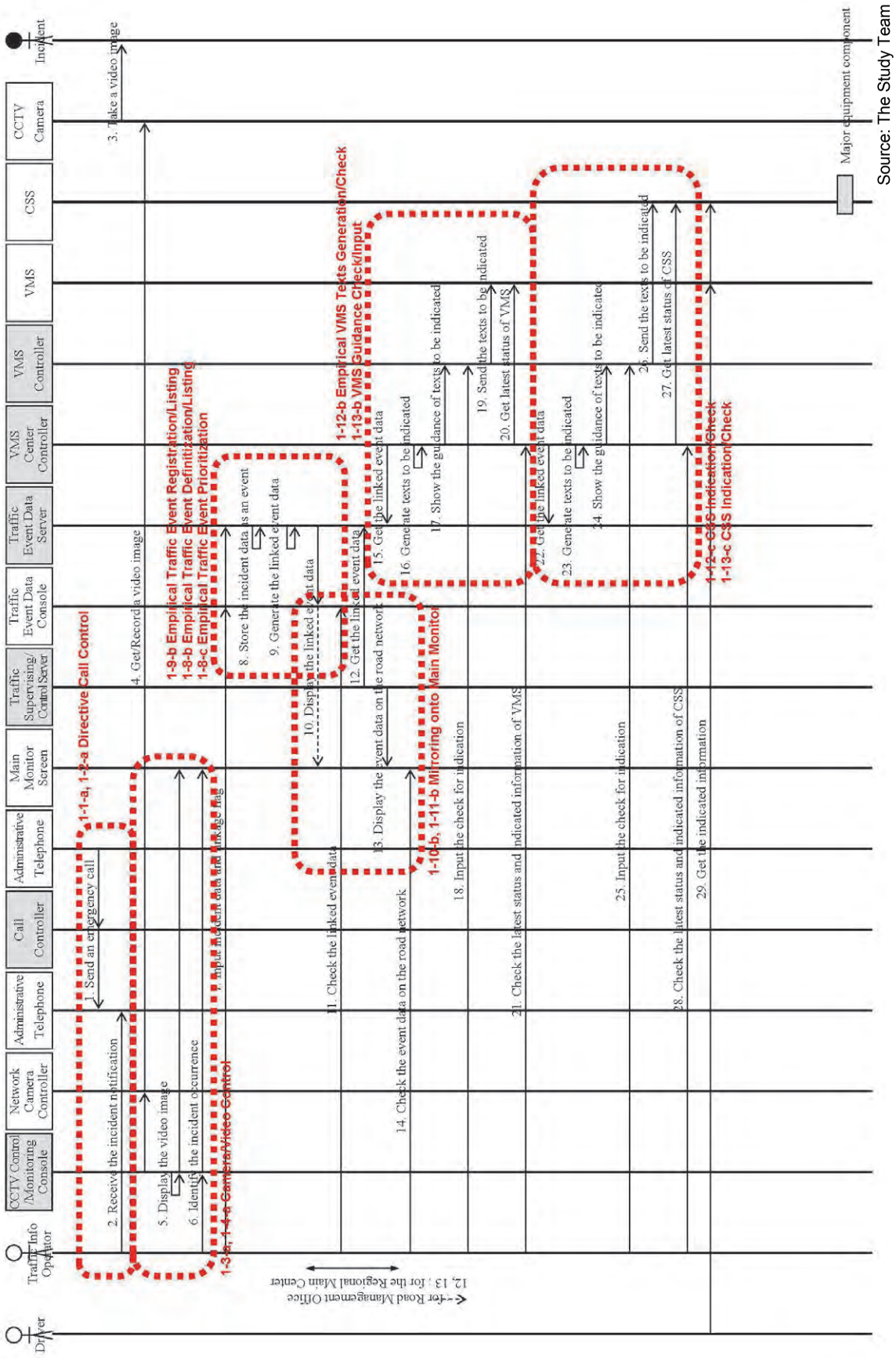
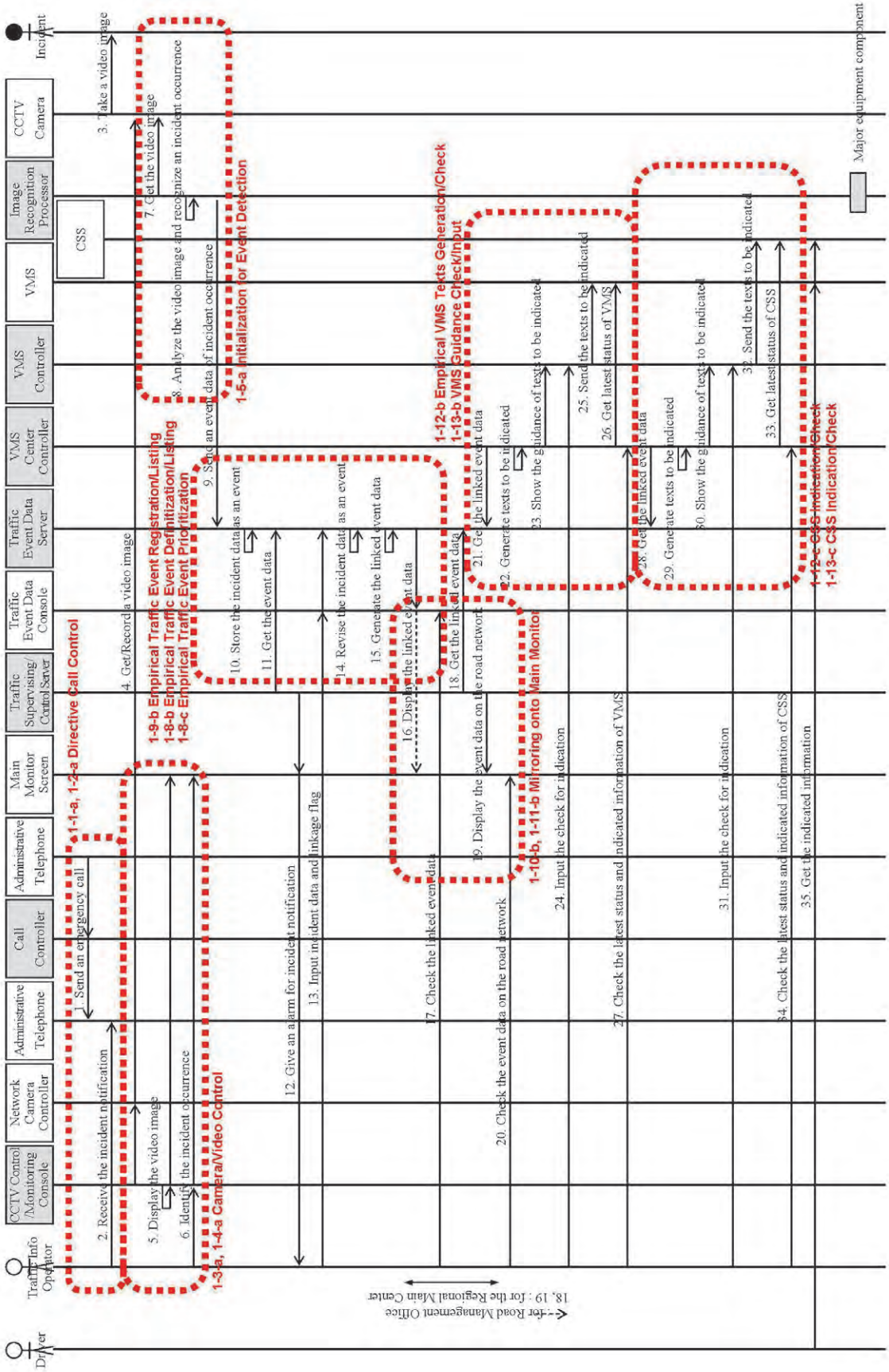


Figure 7.5 Incident Information: 1-(a) by Monitoring at Roadside

Source: The Study Team

Figure 7.6 Incident Information: 1-(b) by Image Recognition



Source: The Study Team

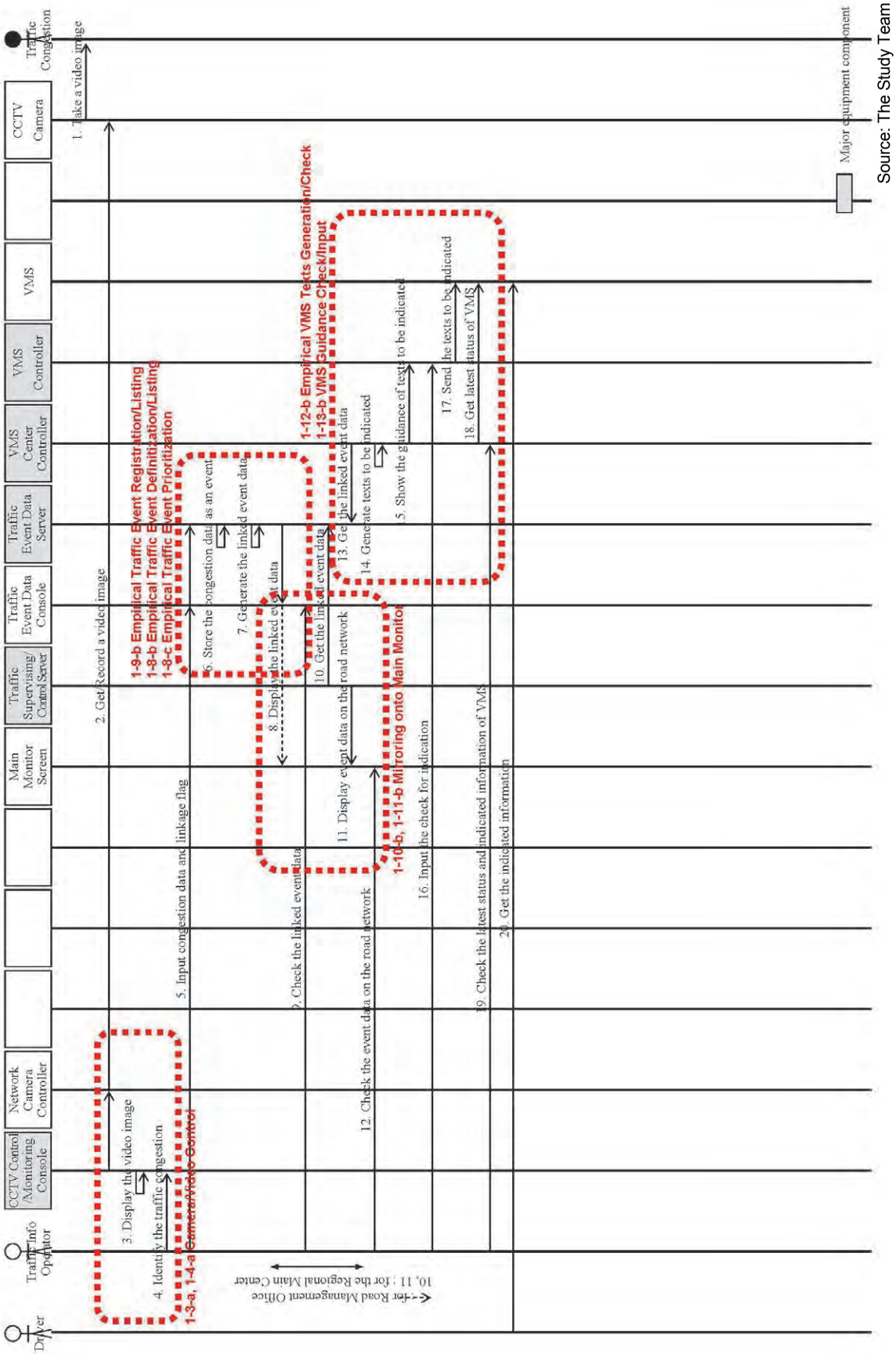
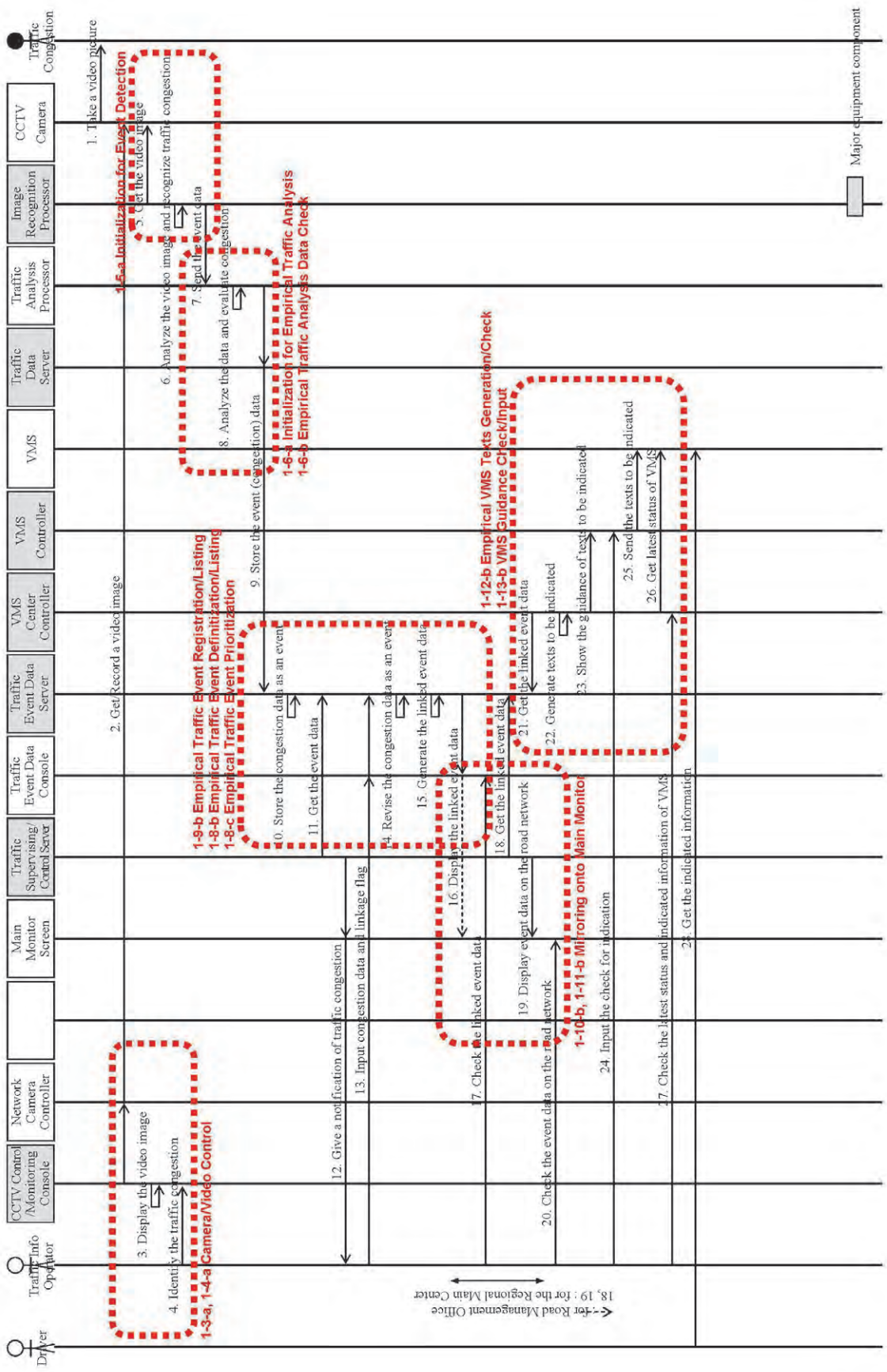


Figure 7.7 Traffic Congestion Information: 2-(a) by Monitoring at Roadside

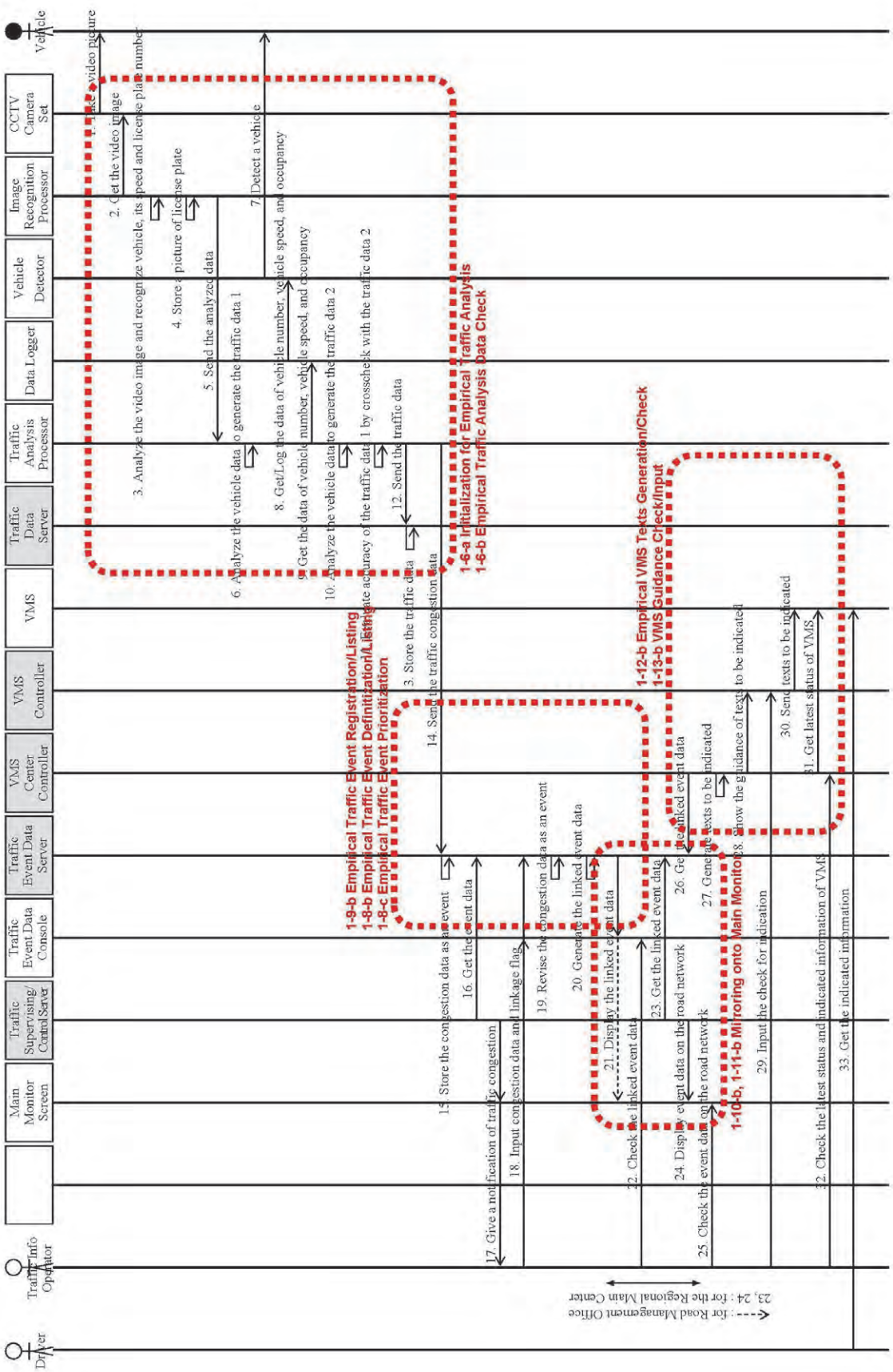
Source: The Study Team

Figure 7.8 Traffic Congestion Information: 2-(b) by Image Recognition



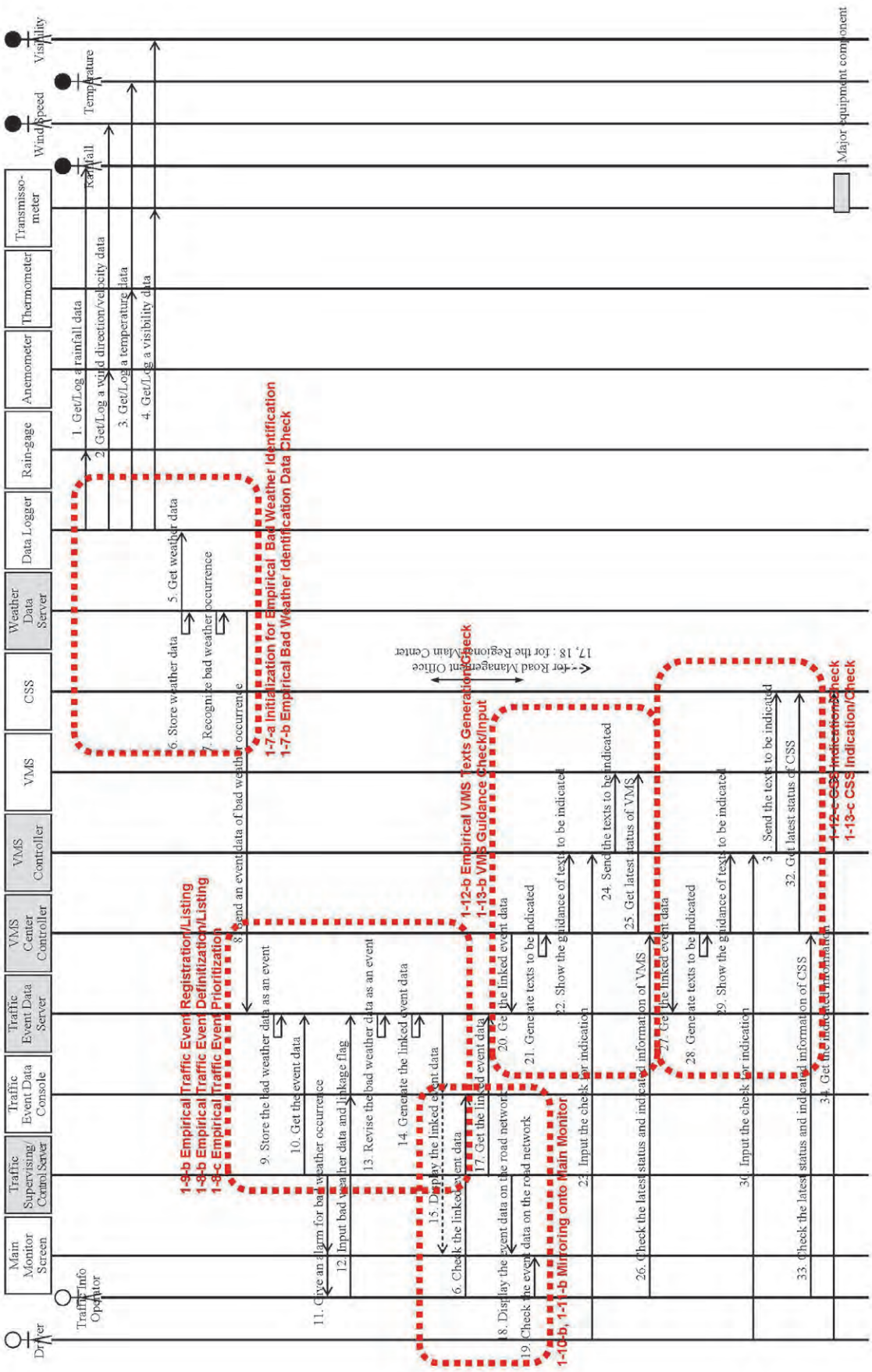
Source: The Study Team

Figure 7.9 Traffic Congestion Information: 2-(c) by Vehicle Detection



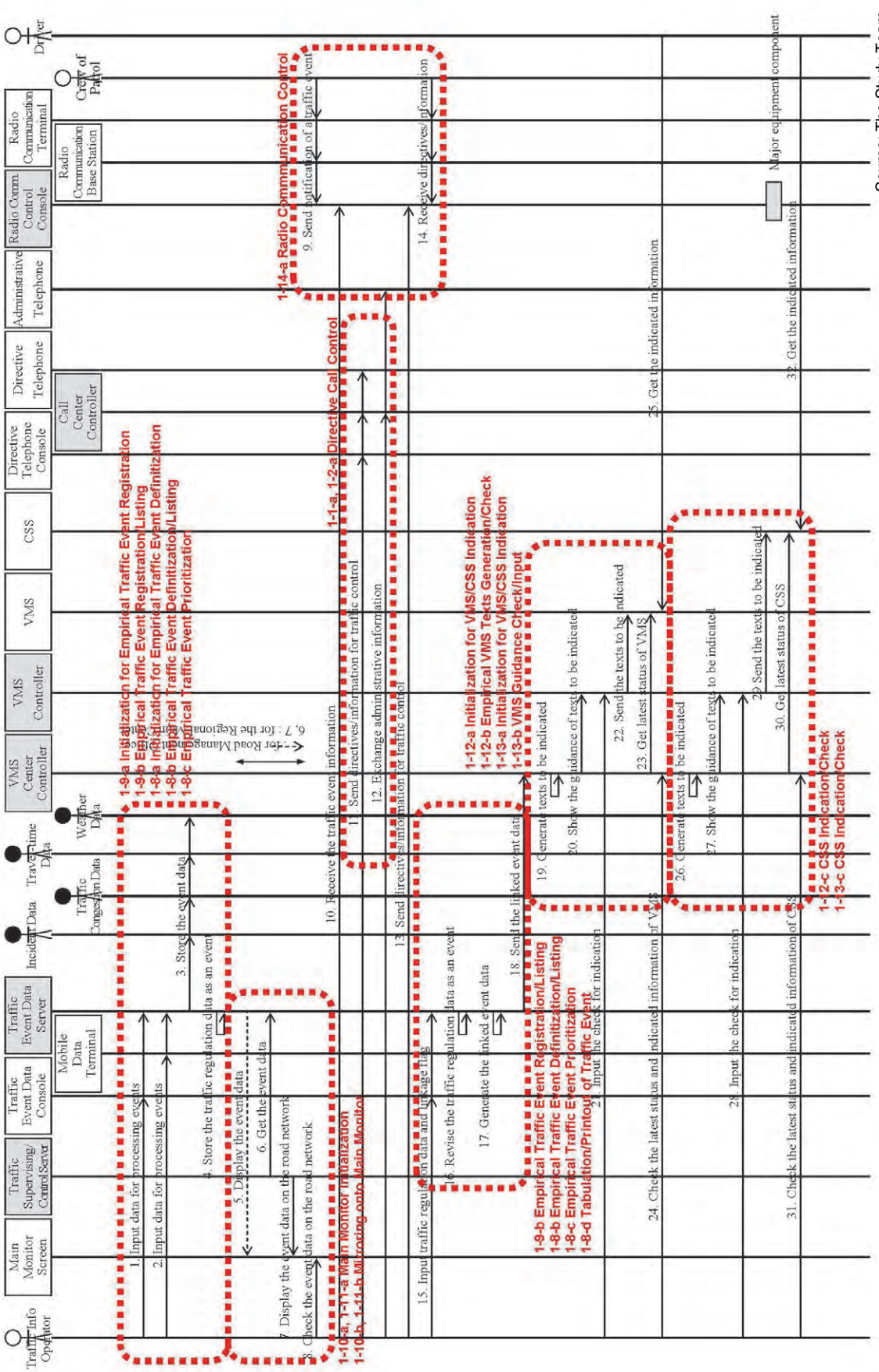
Source: The Study Team

Figure 7.10 Weather Information: 3-(a) by Weather Sensors



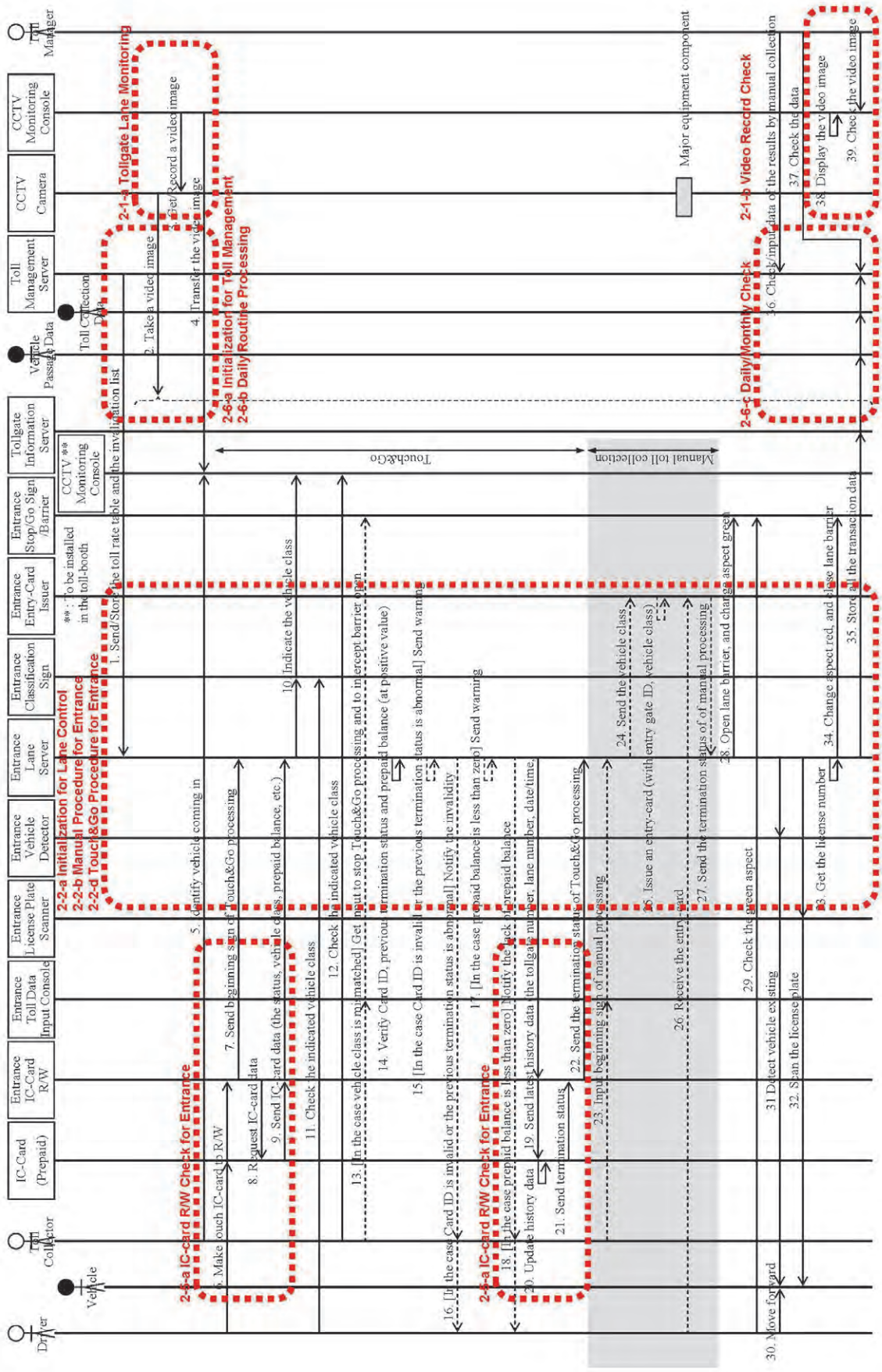
Source: The Study Team

Figure 7.11 Traffic Control Assistance: 4-(a) by Integrated Information



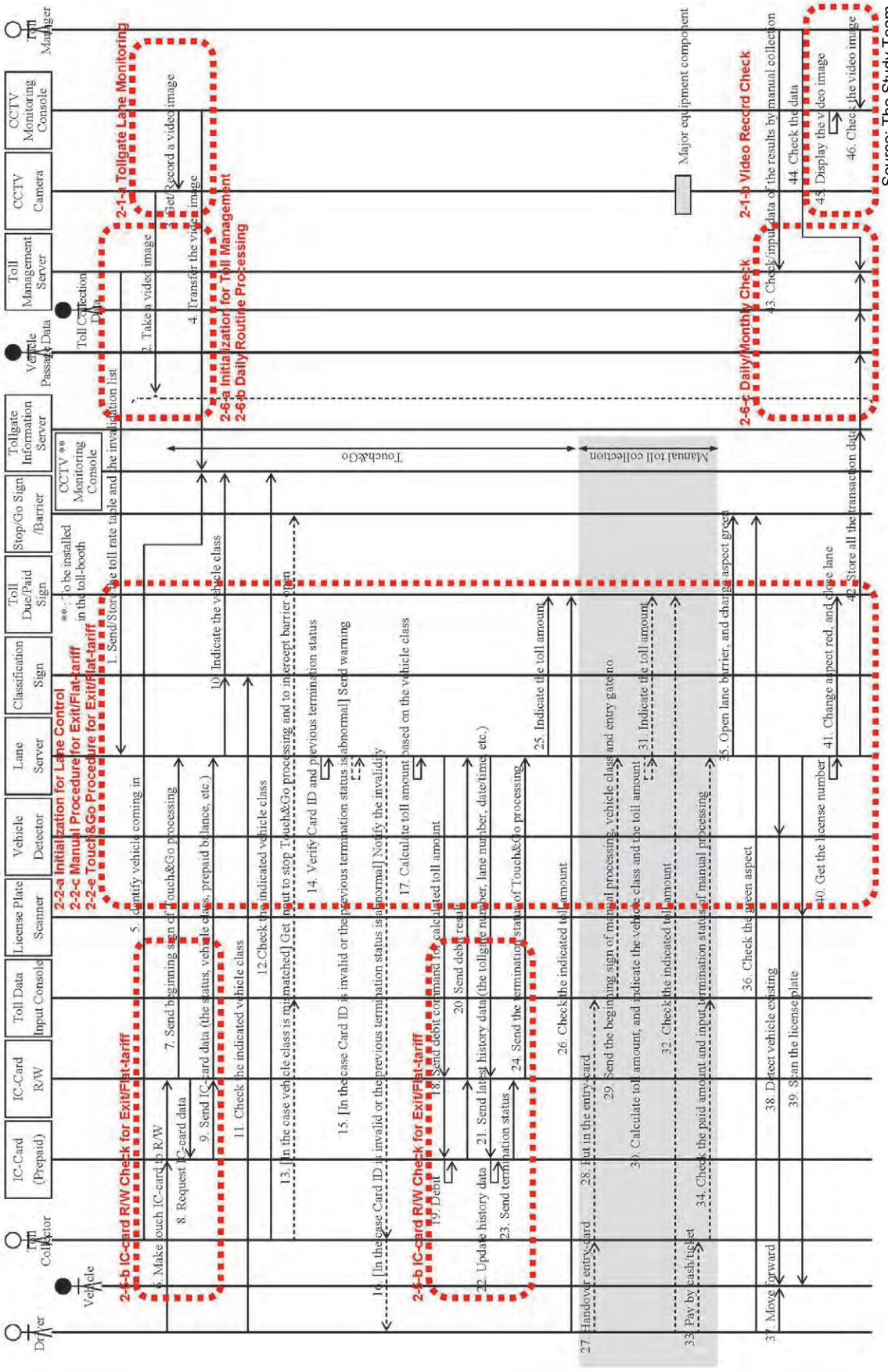
Source: The Study Team

Figure 7.12 Toll Collection: 6-(a) by Touch&Go/Manual (1) (For Reference)



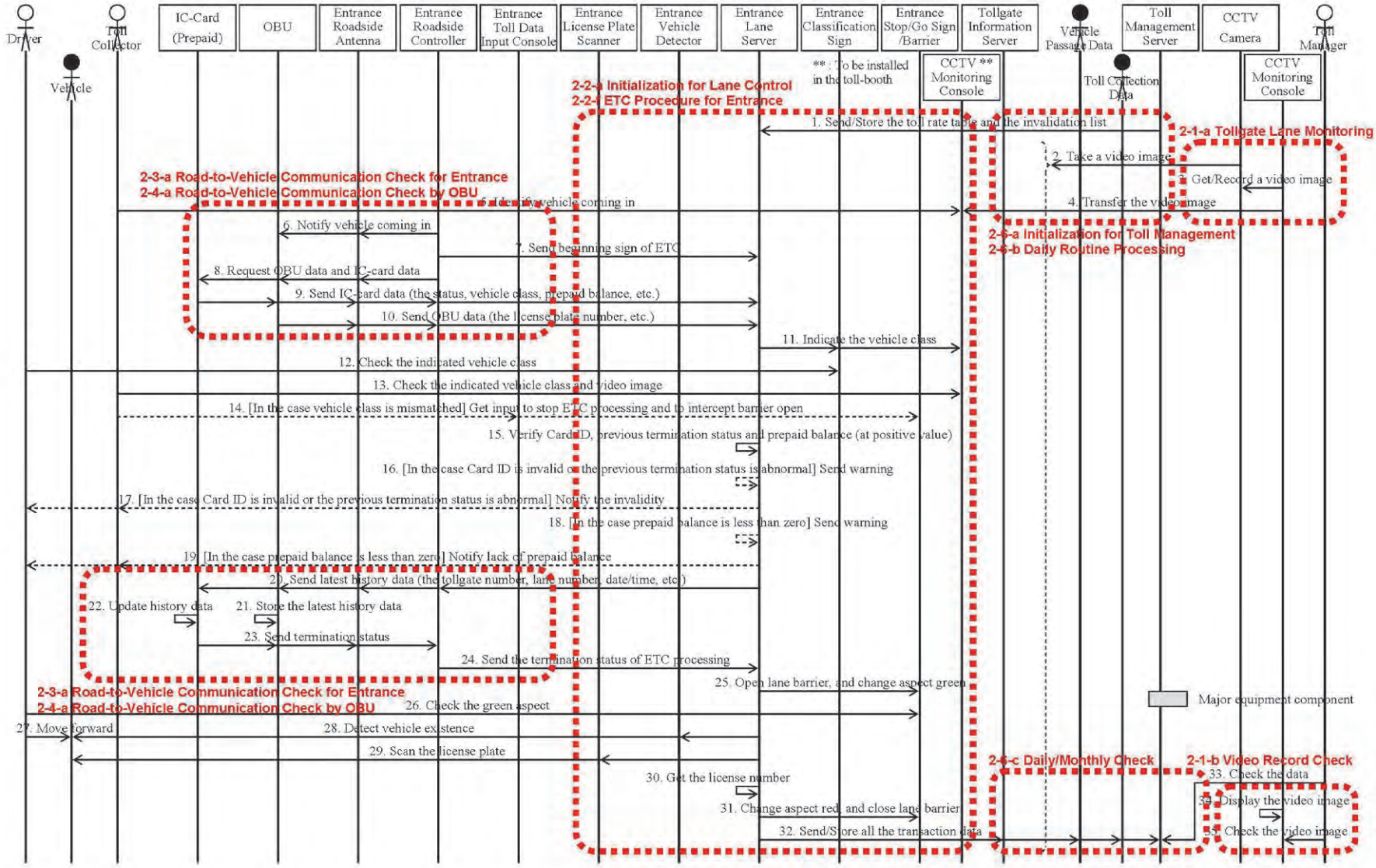
Source: The Study Team

Figure 7.13 Toll Collection: 6-(a) by Touch&Go/Manual (2) (For Reference)



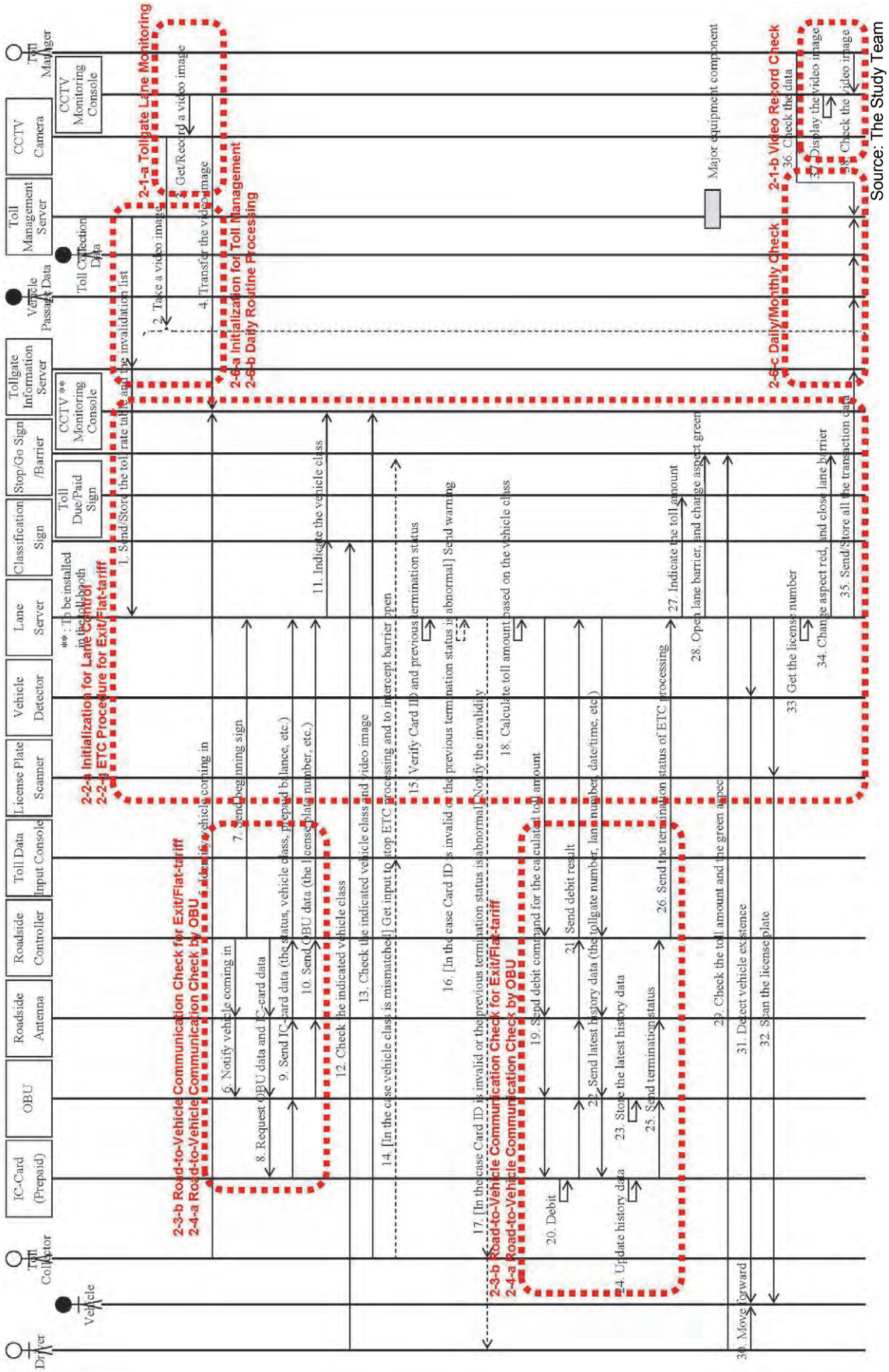
Source: The Study Team

Figure 7.14 Toll Collection: 6-(b) by ETC at Toll-island (2p-OBU) (1) (For Reference)



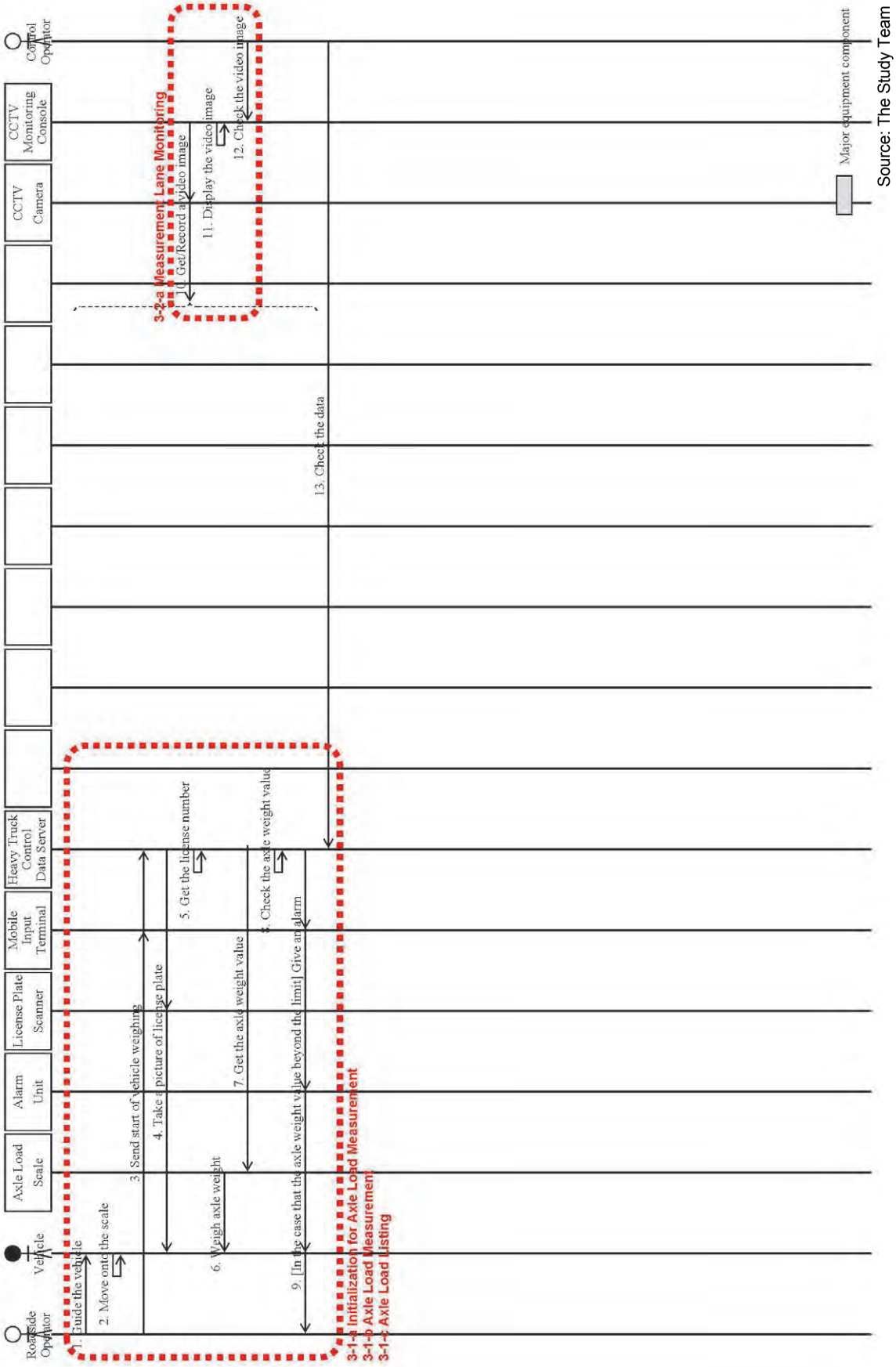
Source: The Study Team

Figure 7.15 Toll Collection: 6-(b) by ETC at Toll-island (2p-OBU) (2) (For Reference)



Source: The Study Team

Figure 7.16 Vehicle Weighing: 8-(a) by Measurement in Motion (For Reference)



Source: The Study Team

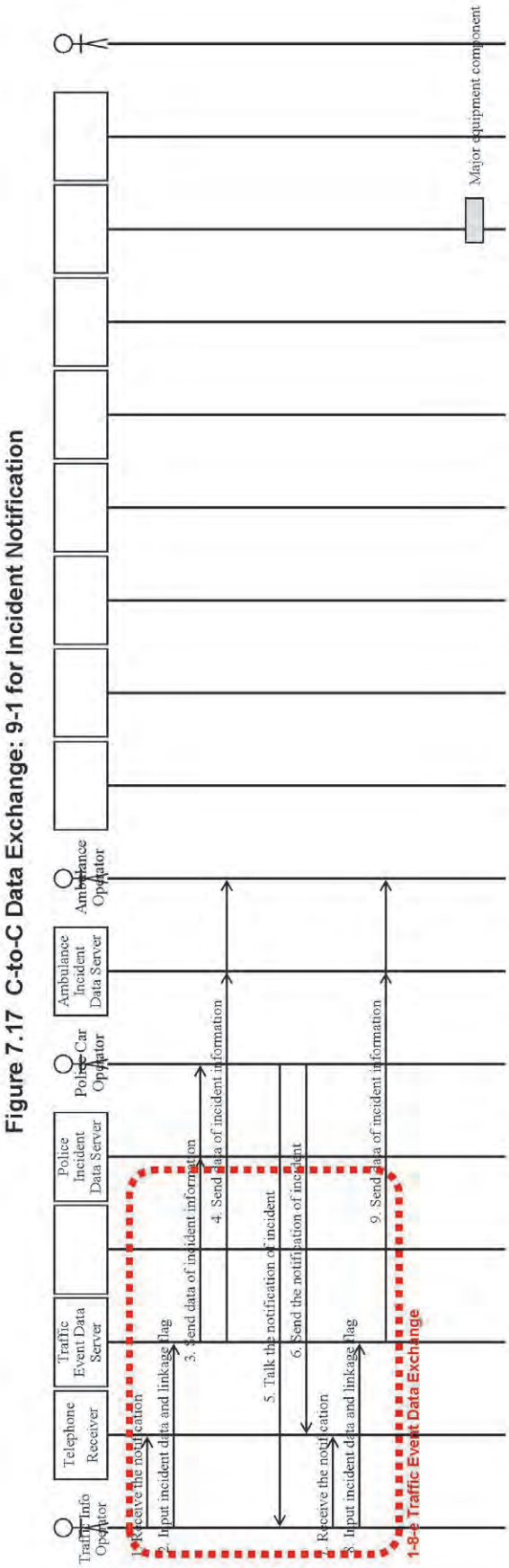


Figure 7.17 C-to-C Data Exchange: 9-1 for Incident Notification

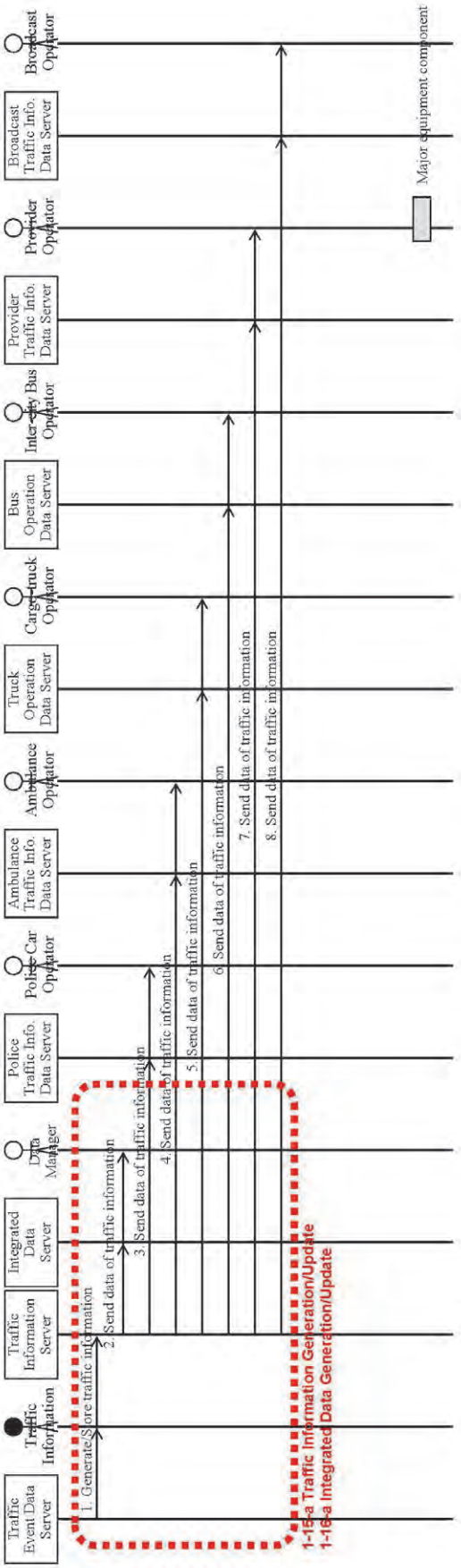


Figure 7.18 C-to-C Data Exchange: 9-2 for Traffic Information

Source: The Study Team

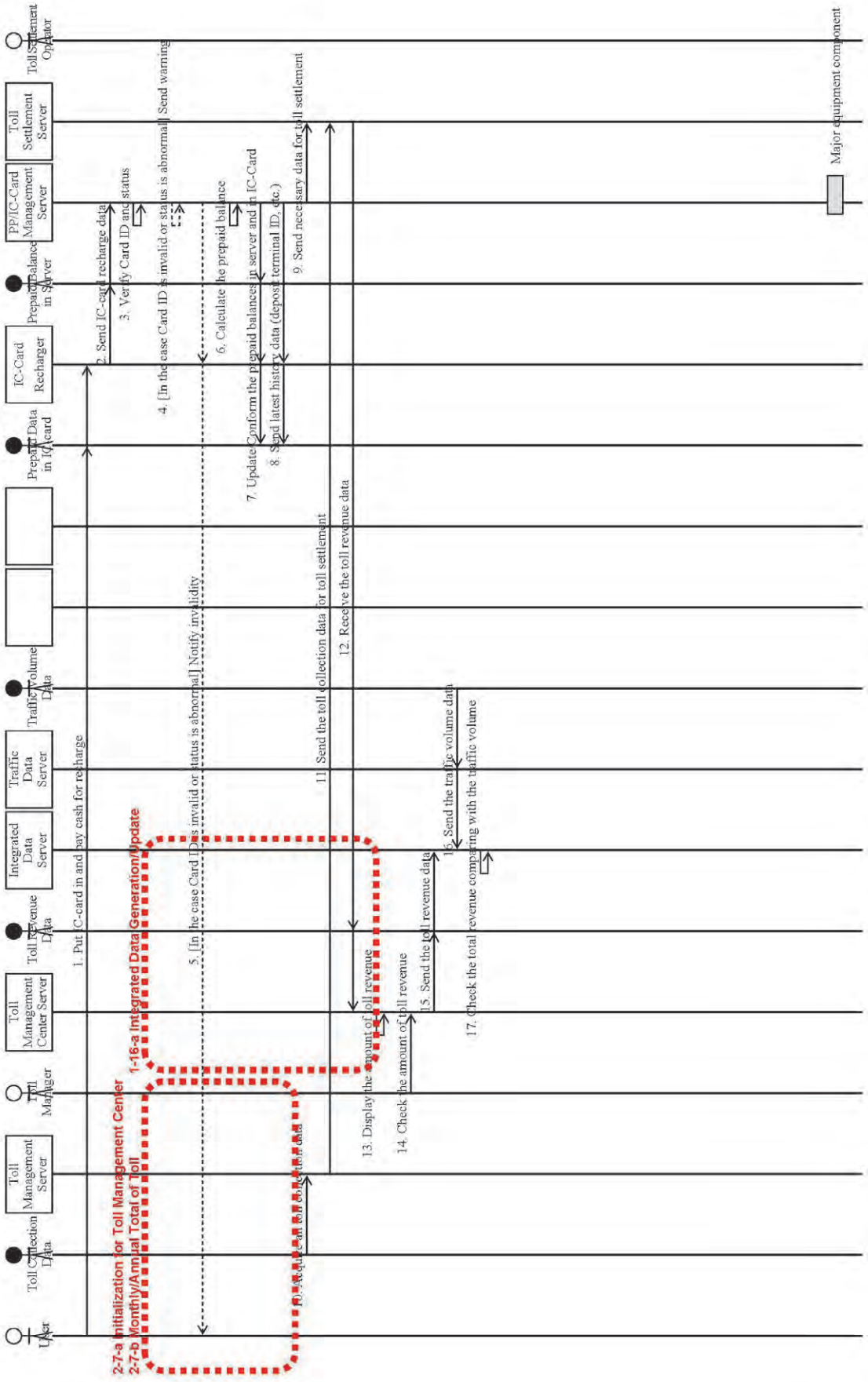


Figure 7.19 C-to-C Data Exchange: 9-3 for Toll Settlement (For Reference)

Source: The Study Team

Figure 7.20 C-to-C Data Exchange: 9-4 for IC-card Operation (For Reference)

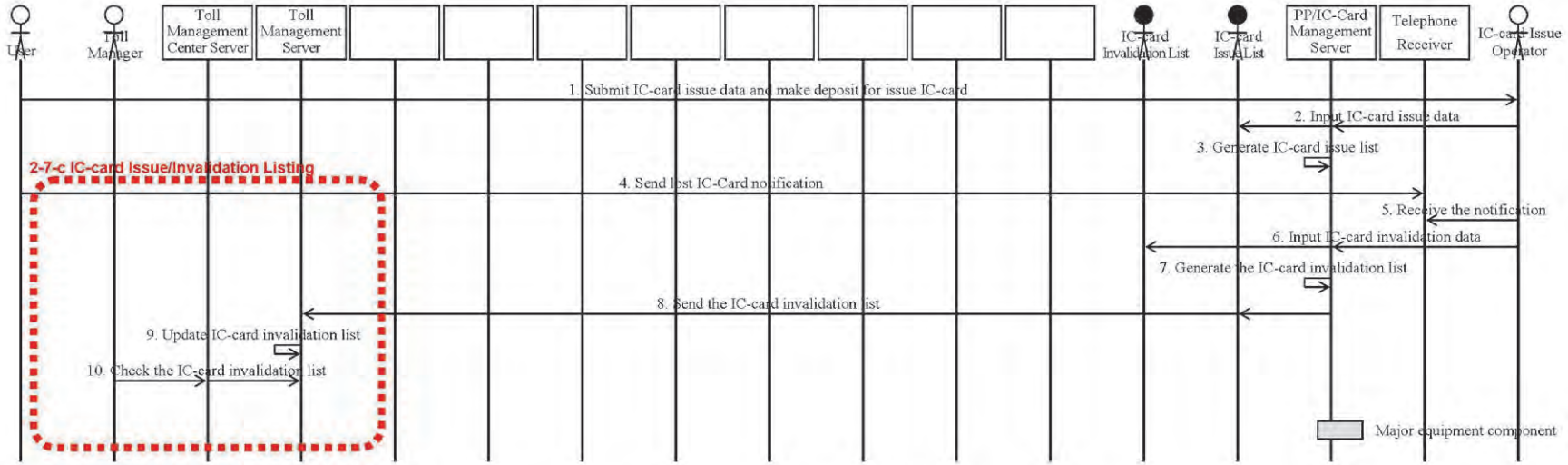
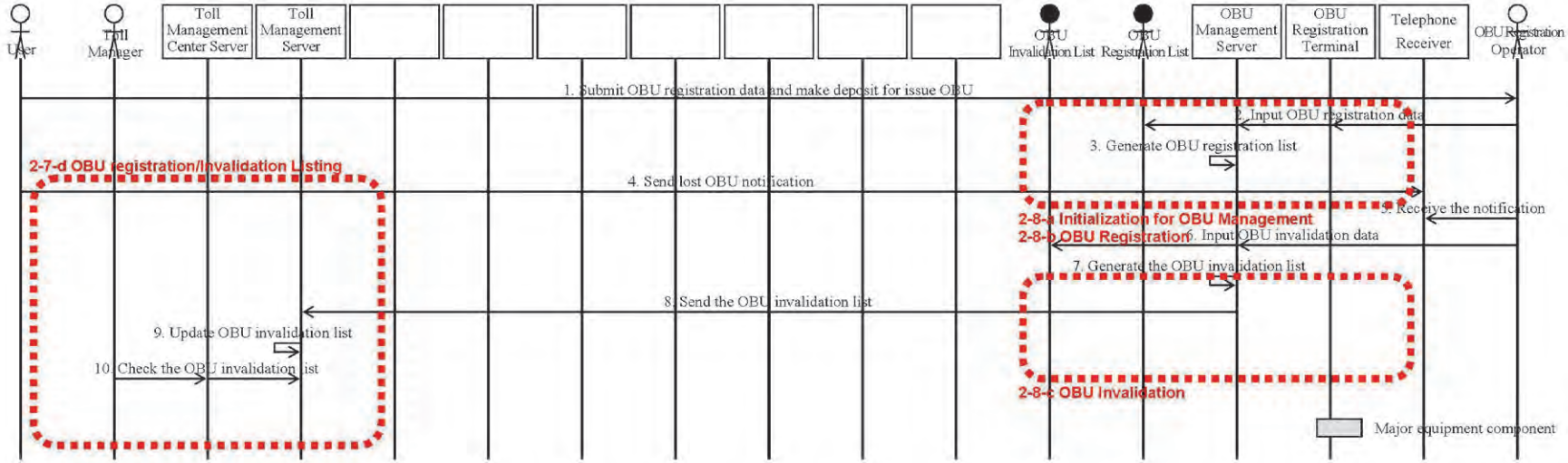
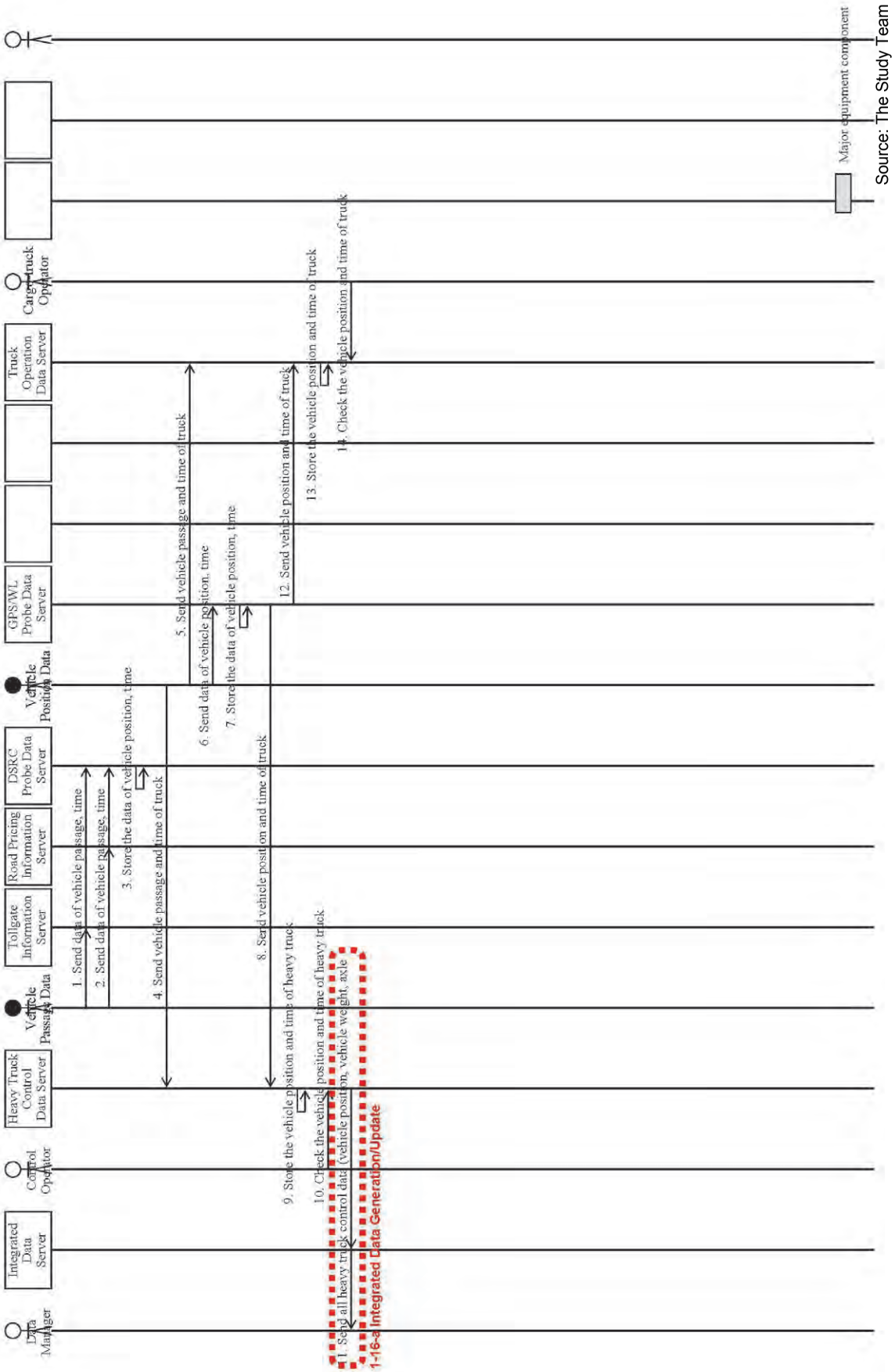


Figure 7.21 C-to-C Data Exchange: 9-5 for OBU Management (For Reference)



Source: The Study Team

Figure 7.22 C-to-C Data Exchange: 9-6 for Heavy Truck Control (For Reference)



Source: The Study Team

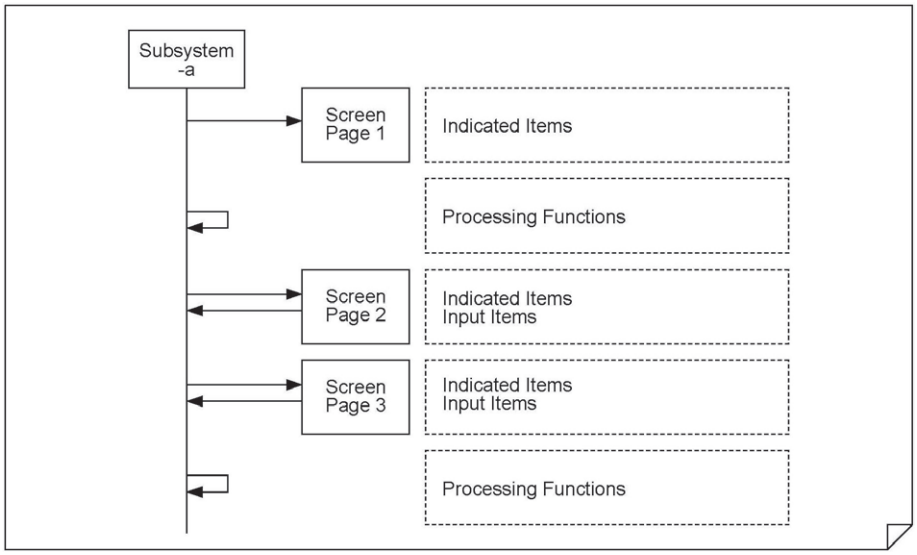
7.3 Conception of Processing/Screen Transition Diagrams

In order to clarify the functions of the application software required for implementing the three Priority ITS User Services, the Processing/Screen Transition Diagrams are to be prepared for the major equipment components of respective Functional Packages and the messages to be exchanged and data to be input/output in the diagrams are to be sorted out in this section.

- Processing/Screen Transition Diagram
- Major Message List
- Primary Data Dictionary.

The Processing/Screen Transition Diagrams are to be illustrated in the form of a time series of processing, screen indication and input/output, which are to be installed in the respective major equipment components in order to actualize the Operating Procedures shown in the previous section.

Figure 7.23 Processing/Screen Transition Diagram



Source: The Study Team

Where it is necessary for the Processing/Screen Transition Diagrams to be conformed with the contents of the Event Tracing Diagrams aforementioned and the Sequence Diagrams prepared for the Implementation Packages.

Firstly, the list of Processing/Screen Transition Diagrams is to be shown in the following page, sorted corresponding to the major equipment components of Functional Packages and the number of Sequence Diagrams aforementioned.

Table 7.3 List of Processing/Screen Transition Diagrams

Functional Packages	Major Equipment Component		Corresponding Sequence Diagram No.																
			1-(a)	1-(b)	2-(a)	2-(b)	2-(c)	4-(a)	5-(a)	6-(a)	6-(b)	7-(b)	9-1	9-4	9-5	9-6	9-7	9-8
			Fig.7.5	Fig.7.6	Fig.7.7	Fig.7.8	Fig.7.9	Fig.7.10	Fig.7.11	Fig.7.12 Fig.7.13	Fig.7.14 Fig.7.15	Fig.7.16	Fig.7.17	Fig.7.18	Fig.7.19	Fig.7.20	Fig.7.21	Fig.7.22
1.Traffic Information/ Control System	Call Controller (RMC)	1-1	a	a					a									
	Call Controller (RMO)	1-2	a	a														
	CCTV Control/Monitoring Console (RMC)	1-3	a	a	a	a												
	CCTV Control/Monitoring Console (RMO)	1-4	a	a	a	a												
	Image Recognition Processor (RMO)	1-5		a		a												
	Traffic Data Server (RMC)	1-6					a,b											
	Weather Data Server (RMC)	1-7						a,b										
	Traffic Event Data Server (RMC)	1-8	b,c	b,c	b,c	b,c	b,c	b,c	a,b,c,d				e					
	Traffic Event Data Server (RMO)	1-9	b	b	b	b	b	b	a,b									
	Traffic Supervising/Control Server (RMC)	1-10	b	b	b	b	b	b	a,b									
	Traffic Supervising/Control Server (RMO)	1-11	b	b	b	b	b	b	a,b									
	VMS Center Controller (RMC)	1-12	b,c	b,c	b	b	b	b,c	a,b,c									
	VMS Controller (RMO)	1-13	b,c	b,c	b	b	b	b,c	a,b,c									
	Radio Comm. Controller (RMO)	1-14							a									
	Traffic Information Server (RMC)	1-15												a				
	Integrated Data Server (VEA)	1-16												a	a			a
2.Toll Collection/ Management System	CCTV Monitoring Console (TO)	2-1								a,b	a,b							
	Lane Server (TO)	2-2								a,b,c,d,e	a,f,g							
	Roadside Controller (Roadside)	2-3									a,b							
	OBU (In-vehicle)	2-4									a							
	IC-card R/W (Roadside)	2-5								a								
	Toll Management Server (TO)	2-6								a,b,c	a,b,c							
	Toll Management Center Server (TMO)	2-7													a,b	c	d	
	OBU Management Server (OMC)	2-8															a,b,c	
3.Vehicle Weighing System	Heavy Truck Control Data Server (TO)	3-1										a,b,c						
	CCTV Monitoring Console (TO)	3-2										a						

Note, RMC: Regional Main center, RMO: Road Management Office, VEA: Expressway Management Agency, TO: Toll Office, TMC: Toll Management Center, OMC: OBU Management Center. Greyed out area is "For Reference".

Source: The Study Team

7.4 Traffic Information/Control System

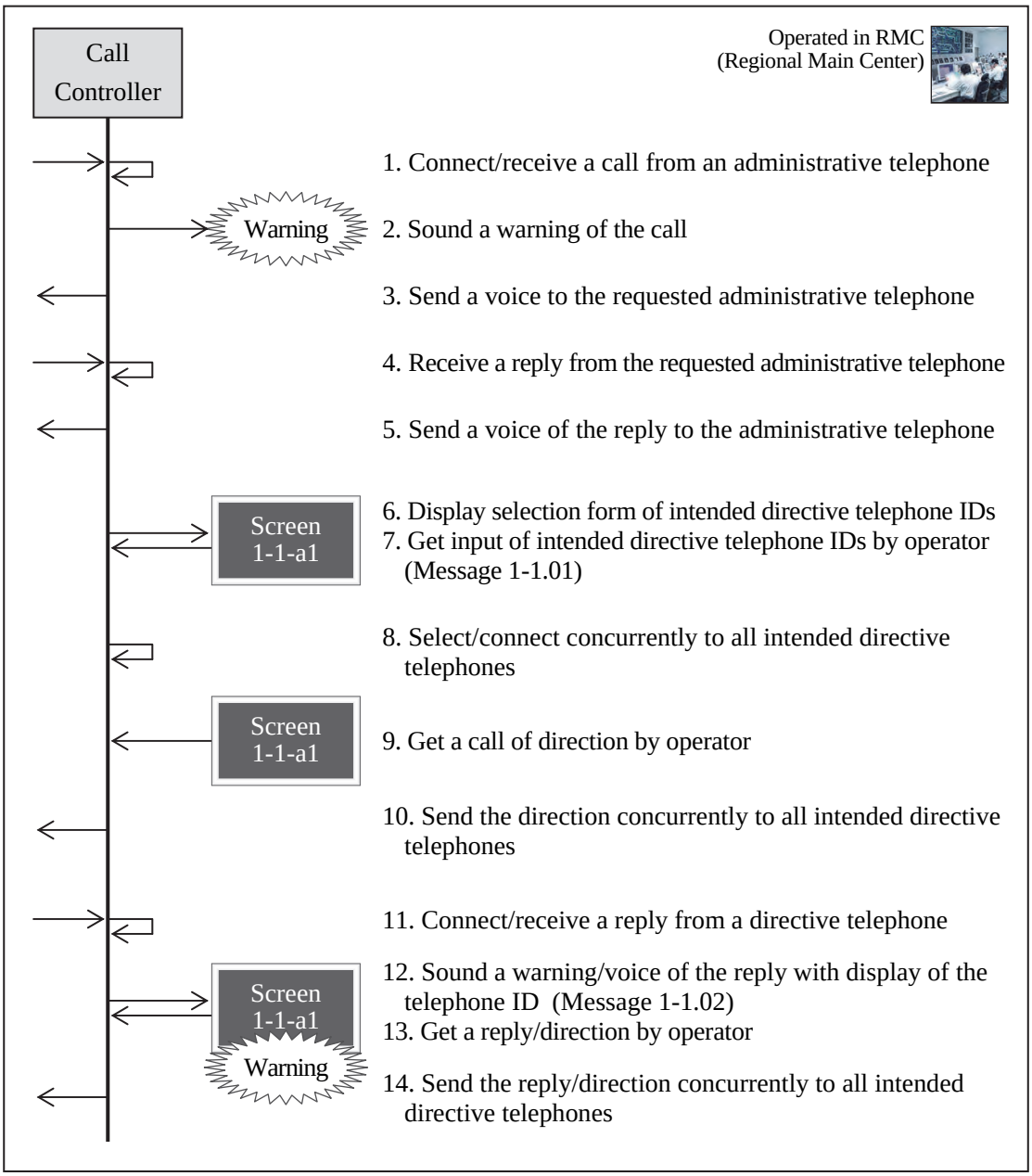
7.4.1 Processing/Screen Transition Diagrams

1) Call Controller (RMC)

1-1-a Directive Call Control

Displaying and processing in series processing in series for issuing the necessary instructions for traffic control from the RMC to the selected RMOs/Departments in charge or to all relevant entities at once, and for exchanging the necessary information.

Figure 7.24 Directive Call Control



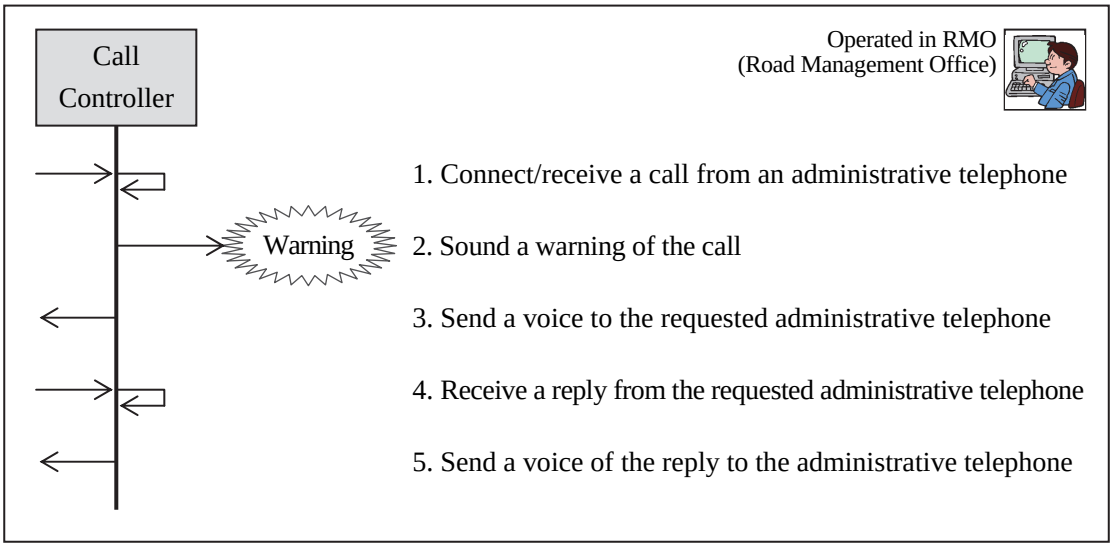
Note: The call controller is to function for the voice communication among all administrative telephones, all directive telephones and the directive console.

2) Call Controller (RMO)

1-2-a Directive Call Control

Displaying and processing in series for selecting the Departments in charge in the responsible RMO, and for exchanging spoken information with them.

Figure 7.25 Directive Call Control



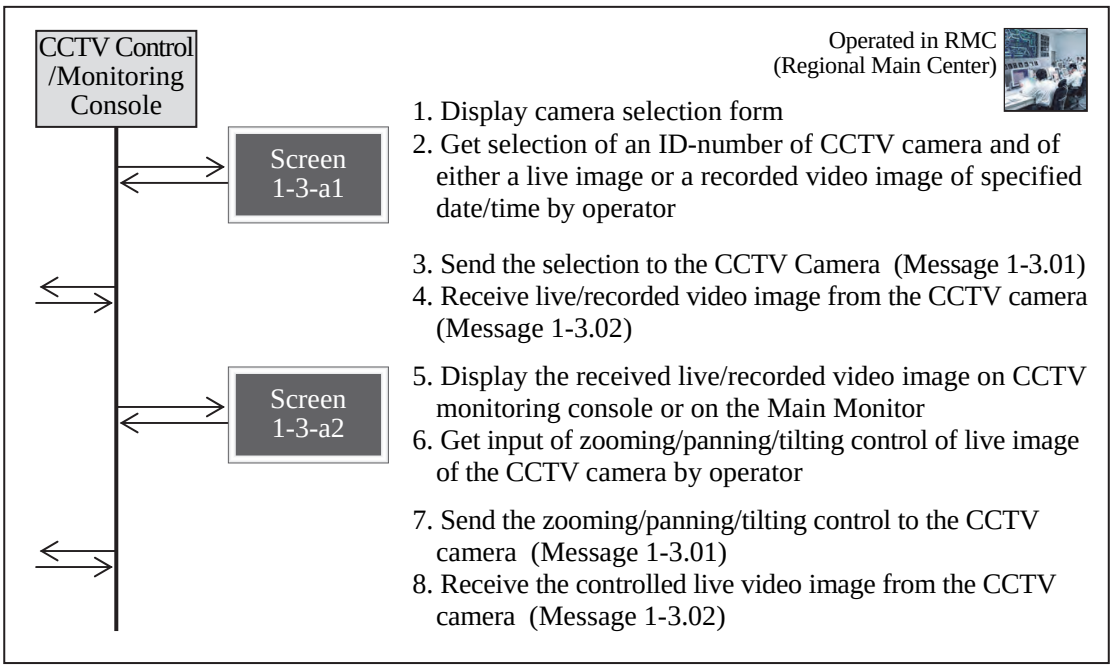
Note: The call controller is to function for the voice communication among administrative telephones.

3) CCTV Control/Monitoring Console (RMC)

1-3-a Camera/Video Control

Displaying and a series of processing for selecting the CCTV Cameras to display the live/ recorded images from the cameras on the CCTV Control/Monitoring Consoles or the Main Monitor Screen, and for controlling the CCTV Cameras as necessary.

Figure 7.26 Camera/Video Control



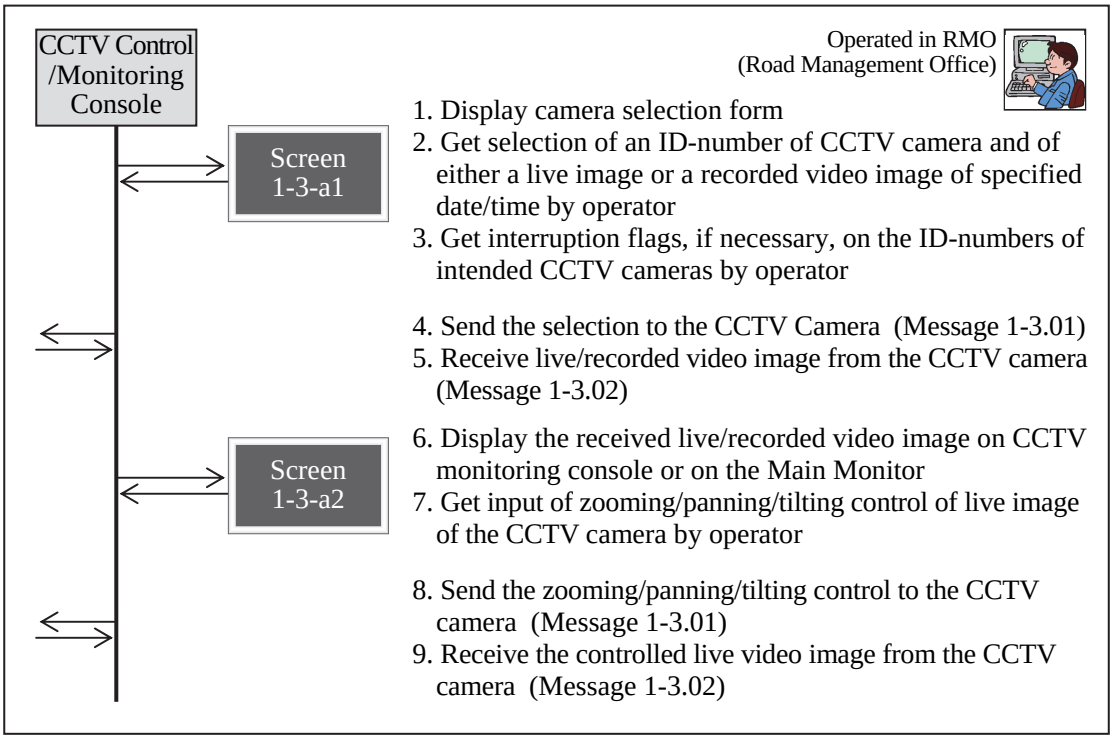
Note: The zooming/panning/tilting control cannot be applied to the CCTV cameras for image recognition.

4) CCTV Control/Monitoring Console (RMO)

1-4-a Camera/Video Control

Displaying and processing in series for selecting the CCTV Cameras to display the live/ recorded images from the cameras on the CCTV Control/Monitoring Consoles or the Main Monitor Screen, and for controlling the CCTV Cameras as necessary.

Figure 7.27 Camera/Video Control



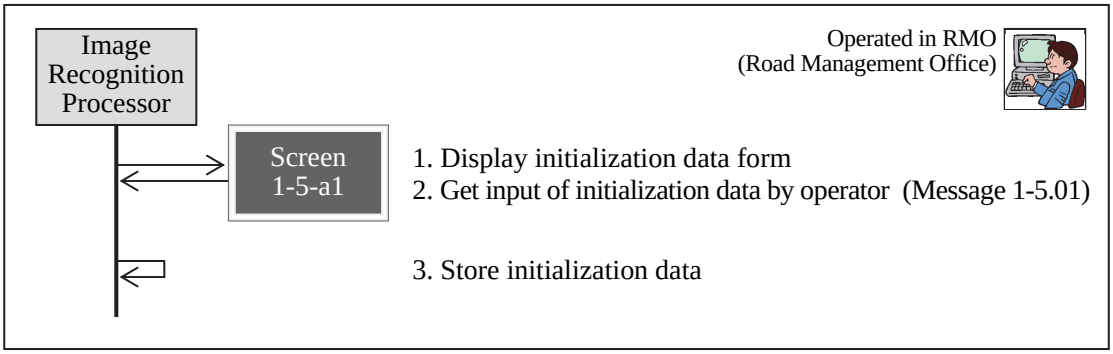
Note: The zooming/panning/tilting control cannot be applied to the CCTV cameras for image recognition. The interruption flags are to be set in order to interrupt the camera control from RMC (Regional Main Center) for the emergency-response during the occurrence of an serious accident.

5) Image Recognition Processor (RMO)

1-5-a Initialization for Event Detection

Displaying and processing in series for inputting the initial data, such as the lists of available detectors and subject traffic events, required for the event detection.

Figure 7.28 Initialization for Event Detection



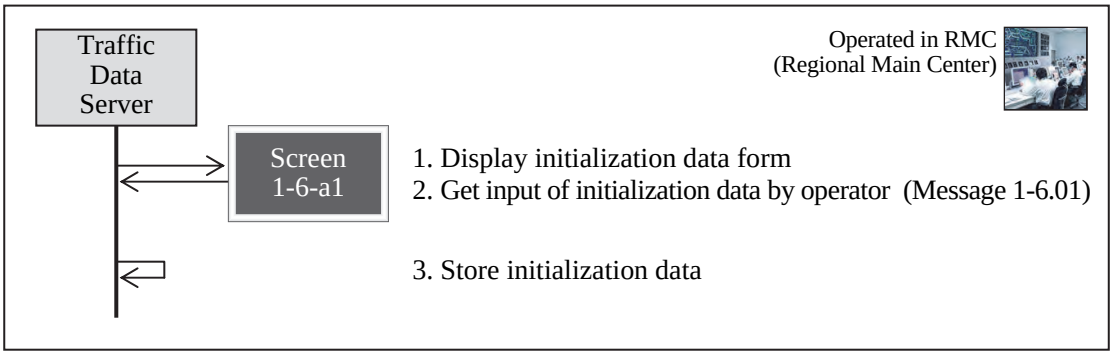
Note: This operation procedure can be executed only in RMC (Regional Main Center).

6) Traffic Data Server (RMC)

1-6-a Initialization for Empirical Traffic Analysis

Displaying and processing in series for inputting the initial data, such as the lists of available detectors and parameters, required for traffic analysis using the empirical method proven effective for expressway networks.

Figure 7.29 Initialization for Empirical Traffic Analysis

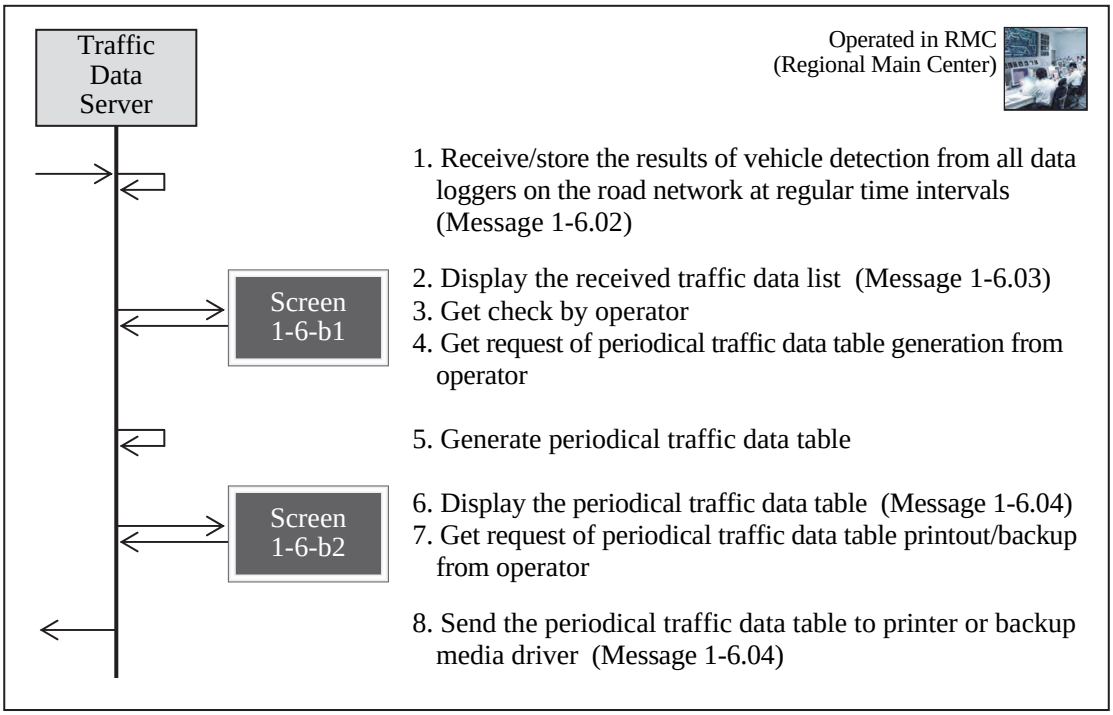


Note: The function of this operation procedure can be executed only in RMC (Regional Main Center).

1-6-b Empirical Traffic Analysis Data Check

Displaying and processing in series for showing a list of values measured by Vehicle Detectors, time dependent change in the measured values and the results of traffic analysis based on the measured values, and for printing the results.

Figure 7.30 Empirical Traffic Analysis Data Check



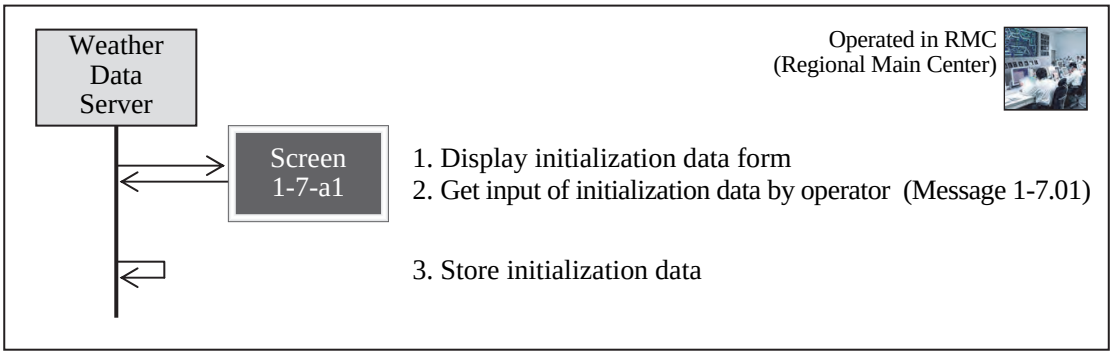
Note: The function of this operation procedure can be executed only in RMC (Regional Main Center).

7) Weather Data Server (RMC)

1-7-a Initialization for Empirical Bad Weather Identification

Displaying and processing in series for inputting the initial data, such as the list of available Weather Sensors and the threshold values for categorizing bad weather, required for bad weather identification using the empirical method proven effective for expressway networks.

Figure 7.31 Initialization for Empirical Bad Weather Identification

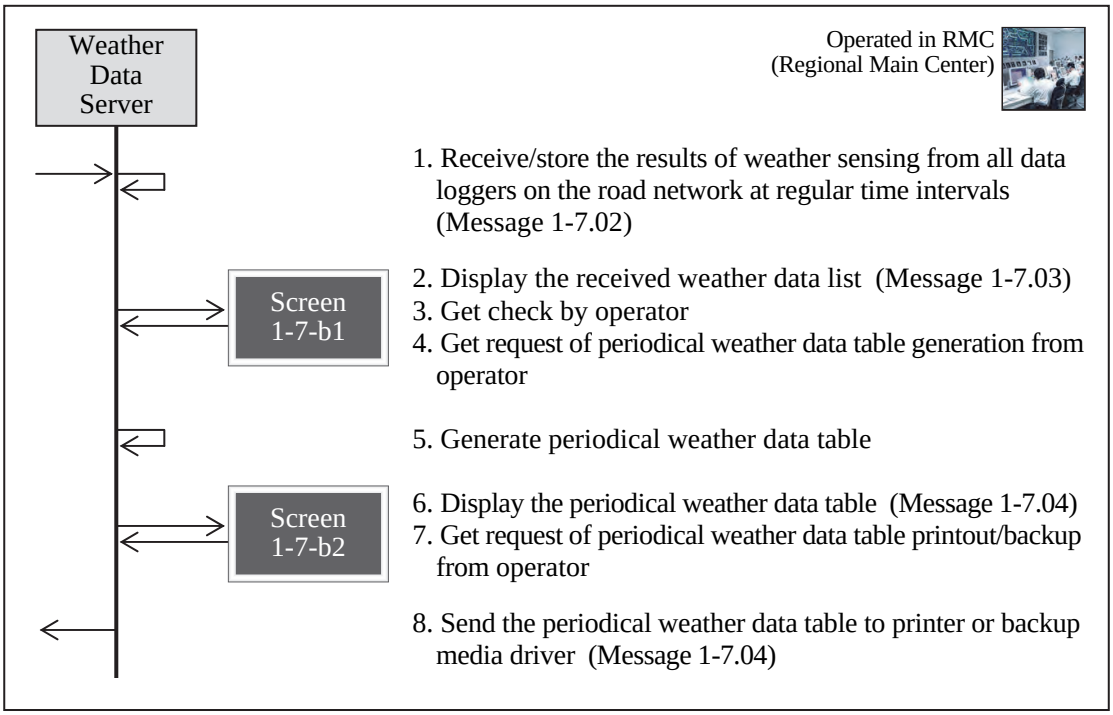


Note: The function of this operation procedure can be executed only in RMC (Regional Main Center).

1-7-b Empirical Bad Weather Identification Data Check

Displaying and processing in series for showing a list of the values measured by Weather Sensors, time dependent change in the values measured by a sensor and for printing the results.

Figure 7.32 Empirical Bad Weather Identification Data Check



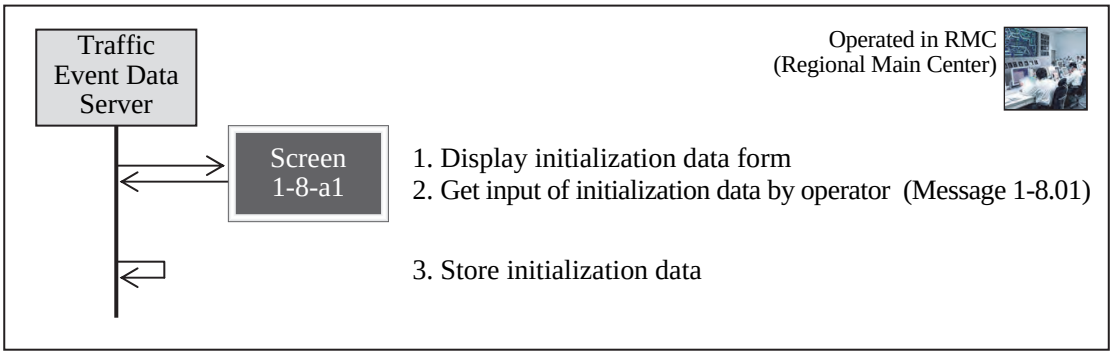
Note: The function of this operation procedure can be executed only in RMC (Regional Main Center).

8) Traffic Event Data Server (RMC)

1-8-a Initialization for Empirical Traffic Event Definitization

Displaying and processing in series for inputting the initial data such as the lists of roads, IC parameters and roadside equipment, required for registering and definitizing the traffic events using the empirical method proven effective for expressway networks.

Figure 7.33 Initialization for Empirical Traffic Event Definitization



1-8-b Empirical Traffic Event Definitization/Listing

Displaying and processing in series for registering candidate types of the traffic events identified by CCTV Cameras or telephone calls, for showing a list of candidate types of traffic events including traffic accidents, congestion and bad weather detected by detectors and sensors and the CCTV Camera IDs nearest to the traffic event sites, for definitizing and correlate the traffic event, and for making periodical checks of the traffic events, all using the empirical method proven effective for expressway networks.

Figure 7.34 Empirical Traffic Event Definitization/Listing (1)

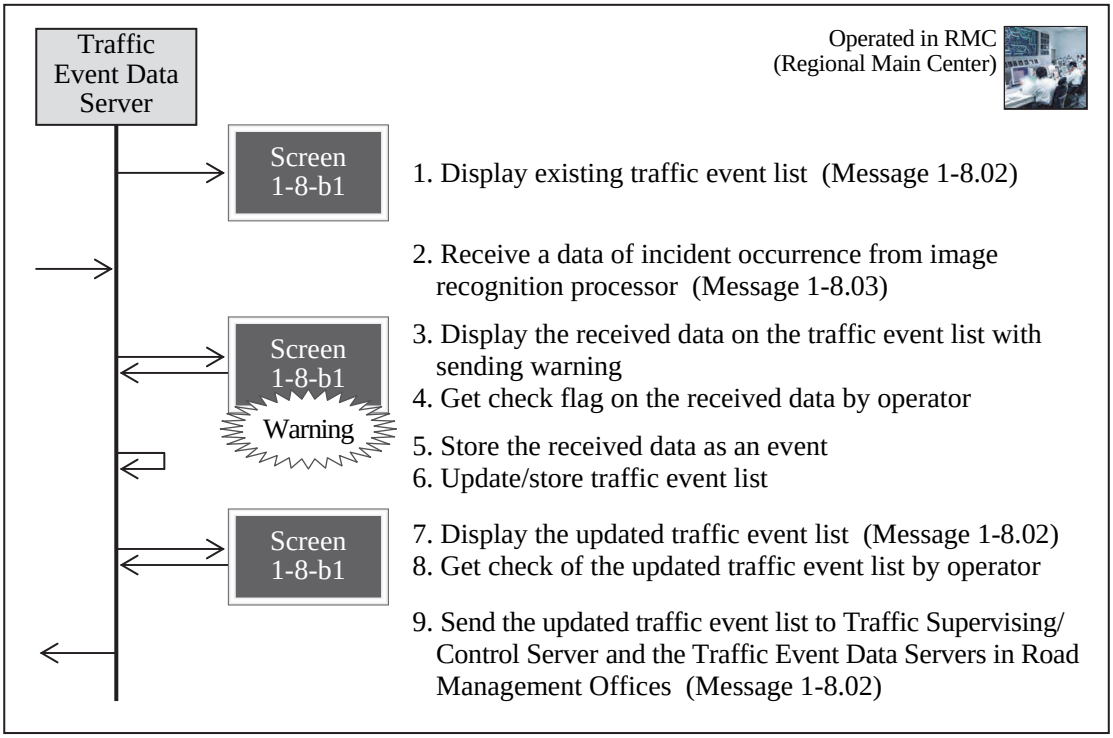


Figure 7.35 Empirical Traffic Event Definitization/Listing (2)

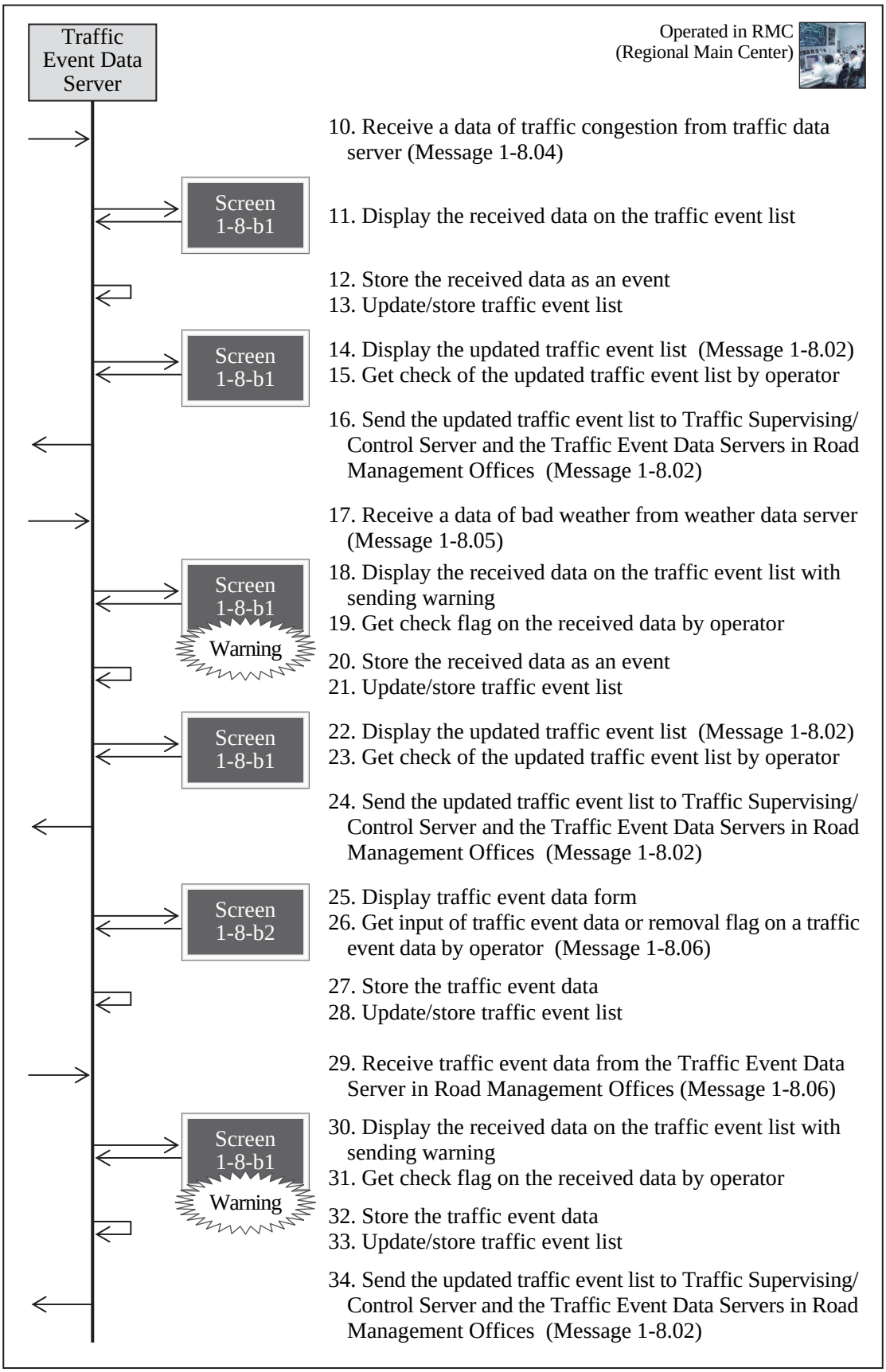
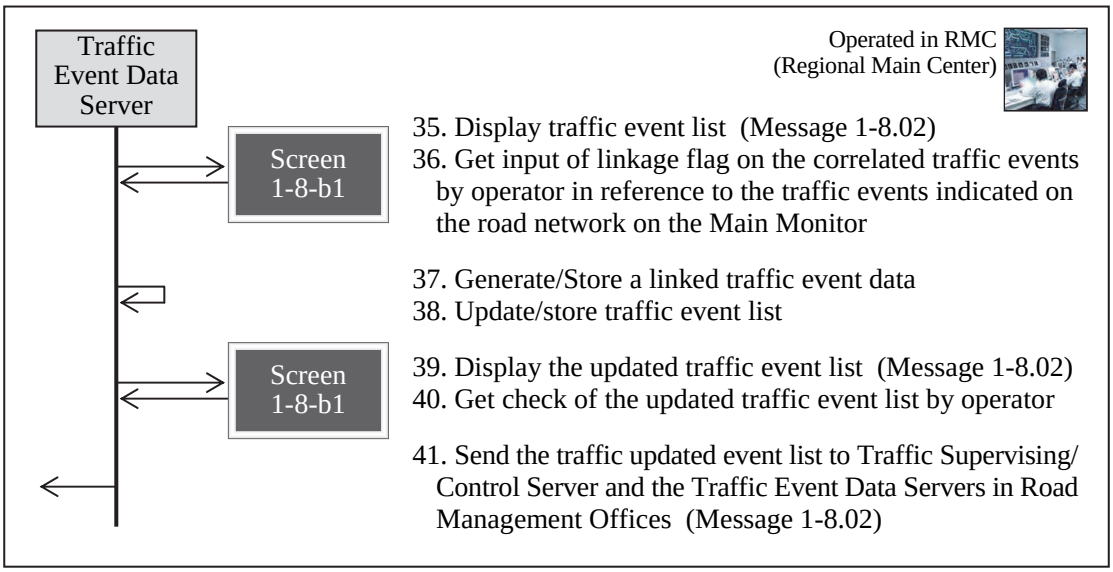


Figure 7.36 Empirical Traffic Event Definitization/Listing (3)

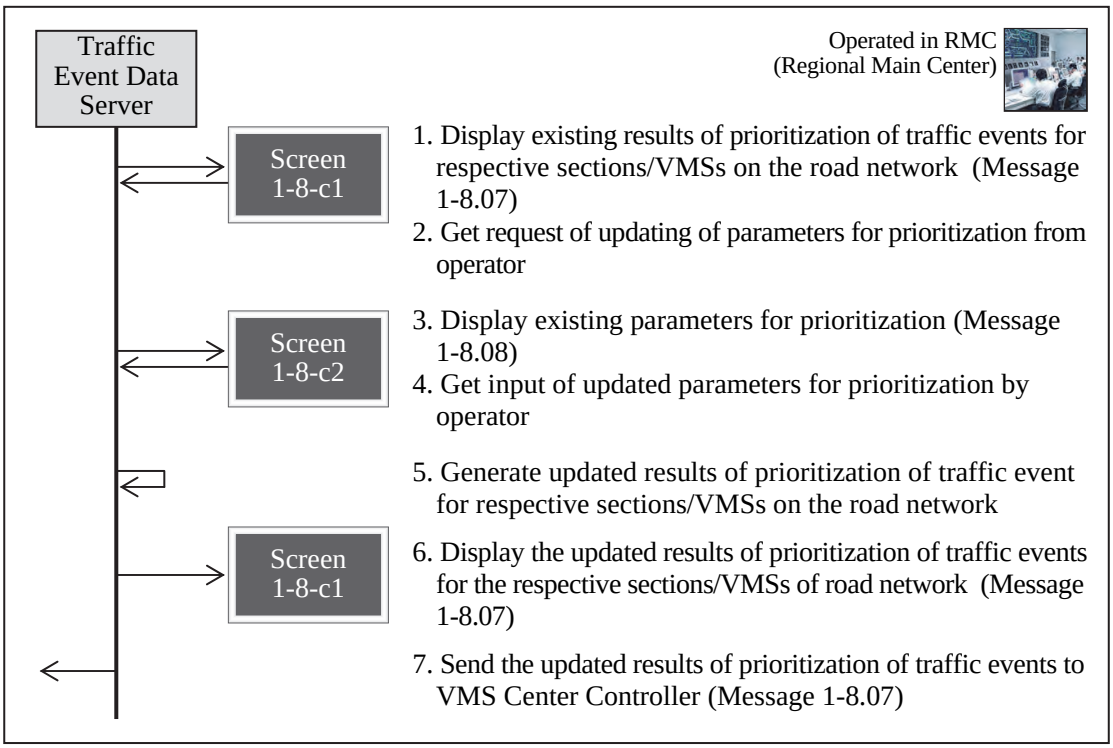


Note: The following steps in this operation procedure can be executed only in RMC (Regional Main Center).
- Procedure for incident occurrence : steps 2 to 9
- Procedure for traffic congestion : steps 10 to 16
- Procedure for bad weather : steps 17 to 24
- Procedure for removal flag : included in step 26
- Procedure for linkage flag :steps 35 to 41.

1-8-c Empirical Traffic Event Prioritization

Displaying and processing in series for prioritizing the information based on the locations and types of the traffic events, using the empirical method proven effective for expressway networks.

Figure 7.37 Empirical Traffic Event Prioritization

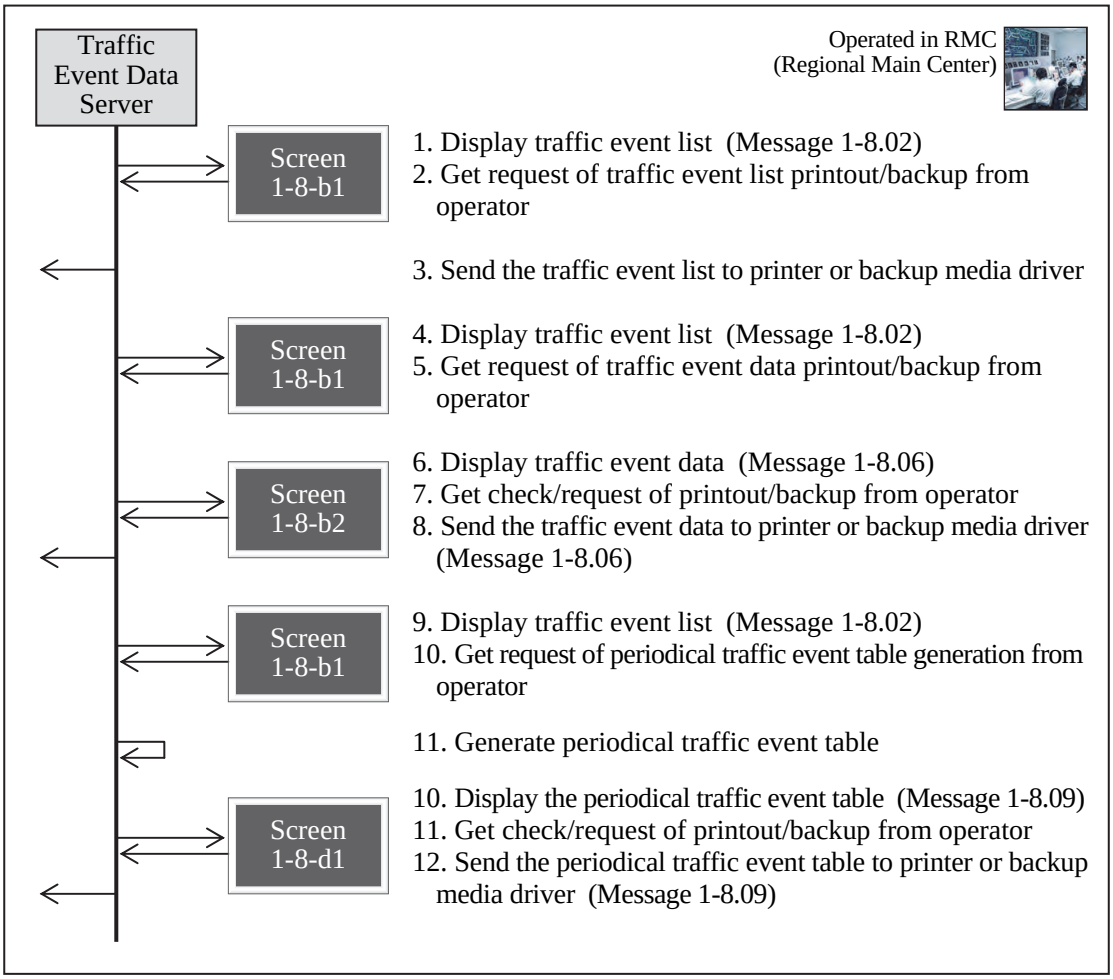


Note: The function of this operation procedure can be executed only in RMC (Regional Main Center).

1-8-d Tabulation/Printout of Traffic Event

Displaying and processing in series for printing a list of traffic events, data of the designated traffic events and a summary table of traffic events occurred during a specific time period.

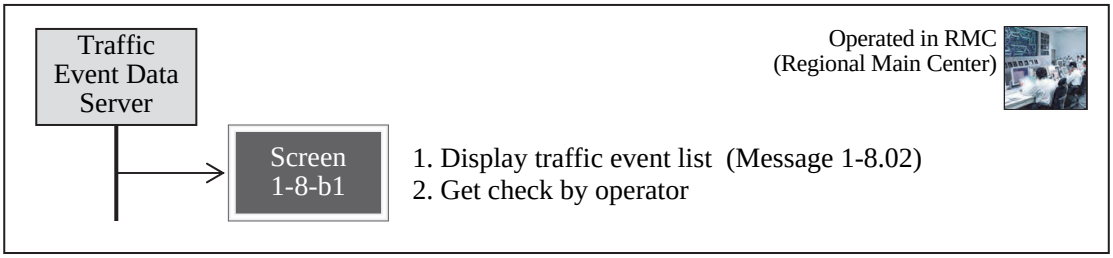
Figure 7.38 Tabulation/Printout of Traffic Event



1-8-e Traffic Event Data Exchange

Displaying and processing in series for sending a list of traffic events to the police and the ambulance services and for receiving the relevant information from them.

Figure 7.39 Traffic Event Data Exchange



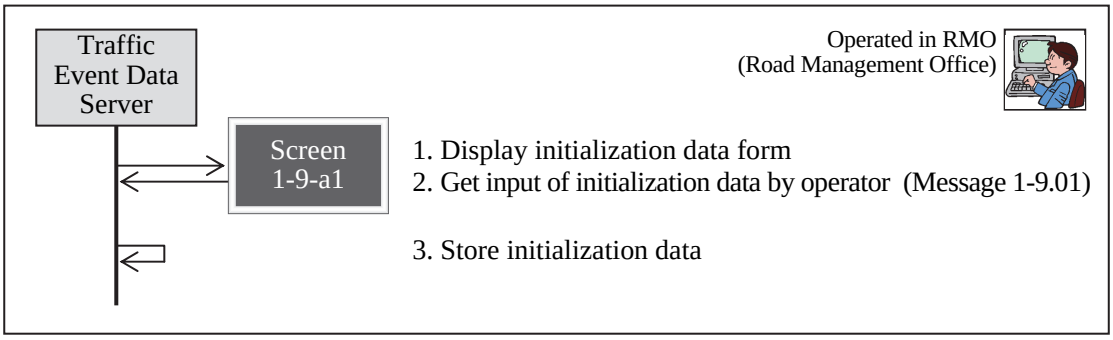
Note: This operation procedure can be executed on a console for traffic police in RMC (Regional Main Center). The console for traffic police has only a function of monitoring the traffic event list in the Traffic Event Data Server. Message exchange between the road operator and the traffic police is to be achieved through the telephones and other exclusive communication network.

9) Traffic Event Data Server (RMO)

1-9-a Initialization for Empirical Traffic Event Registration

Displaying and processing in series for inputting the initial data, such as the lists of roads, IC parameters and roadside equipment, required for registering using the empirical method proven effective for expressway networks.

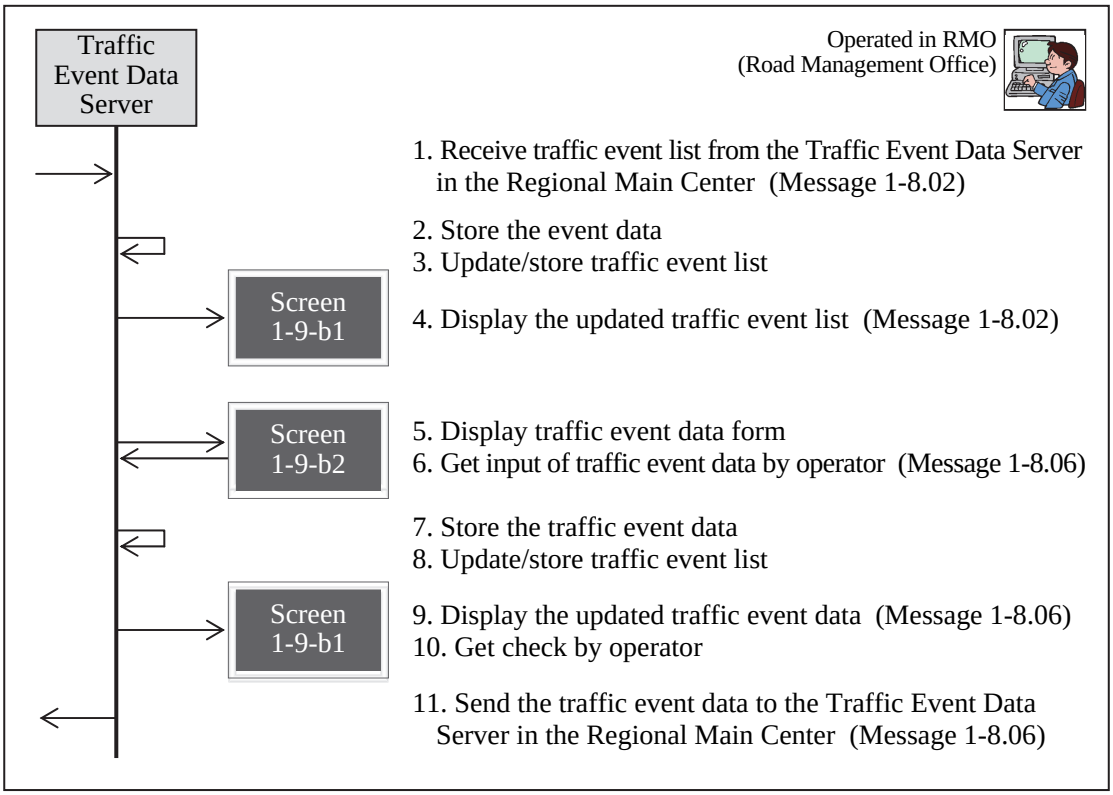
Figure 7.40 Initialization for Empirical Traffic Event Registration



1-9-b Empirical Traffic Event Registration/Listing

Displaying and processing in series for registering candidate types of the traffic events identified by CCTV Cameras or telephone calls, for showing a list of candidate types of traffic events including traffic accidents, congestion and bad weather detected by detectors and sensors, for pick-up showing a list of candidate types of traffic events relevant to the subject RMO and CCTV Camera IDs nearest to the traffic event sites, and for making periodical checks of traffic events, all using the empirical method proven effective for expressway networks.

Figure 7.41 Empirical Traffic Event Registration/Listing

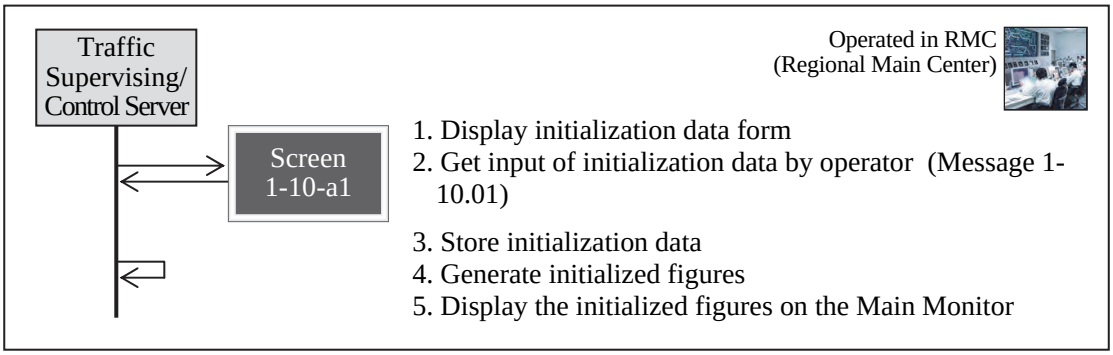


10) Traffic Supervising/Control Server (RMC)

1-10-a Main Monitor Initialization

Displaying and processing in series for inputting the initial data required for showing images on the Main Monitor Screen and for switching the images to the images from multiple CCTV Cameras displayed on the side screens.

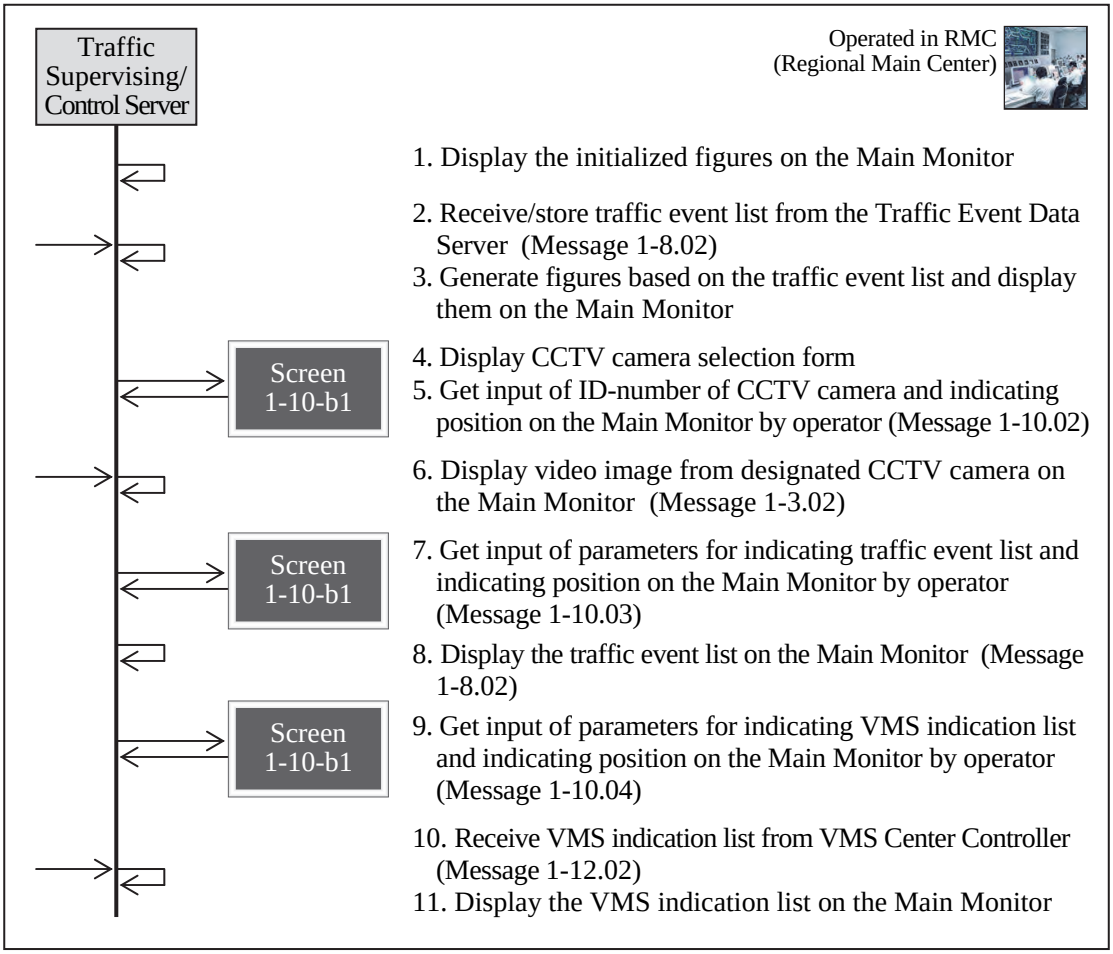
Figure 7.42 Main Monitor Initialization



1-10-b Mirroring onto Main Monitor

Displaying and processing in series for showing, on the Main Monitor Screen, the images of

Figure 7.43 Mirroring onto Main Monitor



Note: This operation procedure is to be executed using the traffic supervising/control console mentioned in Chapter 6.

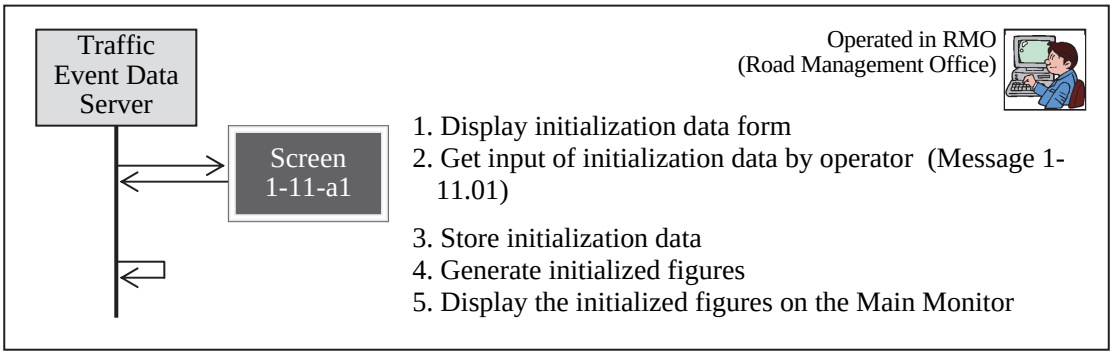
the ID-designated CCTV Cameras, the screen of the Traffic Event Console, and the information to be displayed on VMS.

11) Traffic Supervising/Control Server (RMO)

1-11-a Main Monitor Initialization

Displaying and processing in series for inputting the initial data required for switching displays on the Main Monitor Screen.

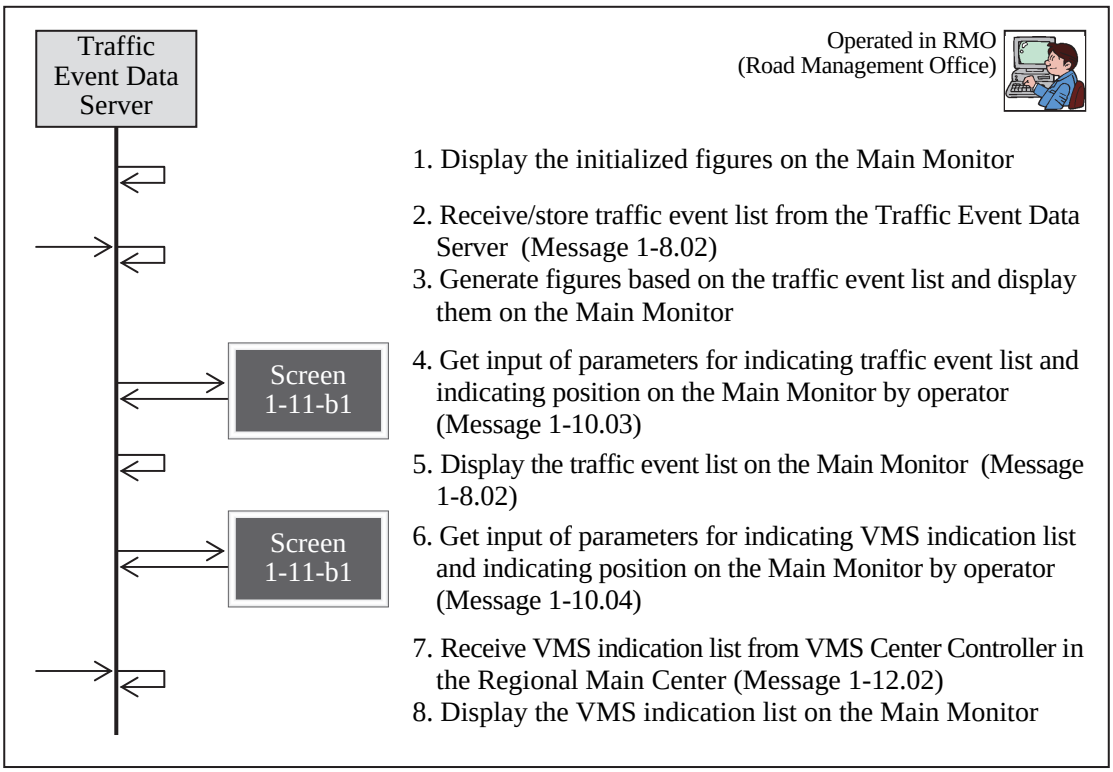
Figure 7.44 Main Monitor Initialization



1-11-b Mirroring onto Main Monitor

Displaying and processing in series for showing, on the Main Monitor Screen, the designated Traffic Event Data Console screen and the information to be displayed on VMS.

Figure 7.45 Mirroring onto Main Monitor



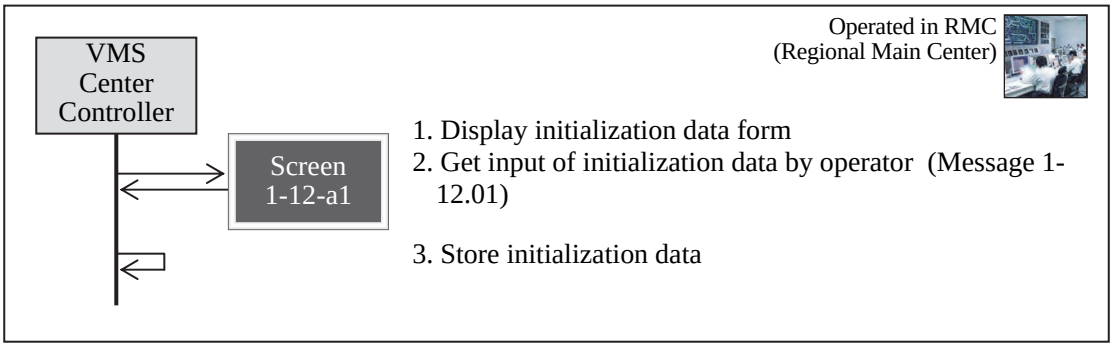
Note: This operation procedure is to be executed using the traffic supervising/control console mentioned in Chapter 6.

12) VMS Center Controller (RMC)

1-12-a Initialization for VMS/CSS Indication

Displaying and processing in series for showing the optimum information on all of VMSs using the empirical method proven effective for expressway networks, and for inputting the initial data required for controlling CSS displays.

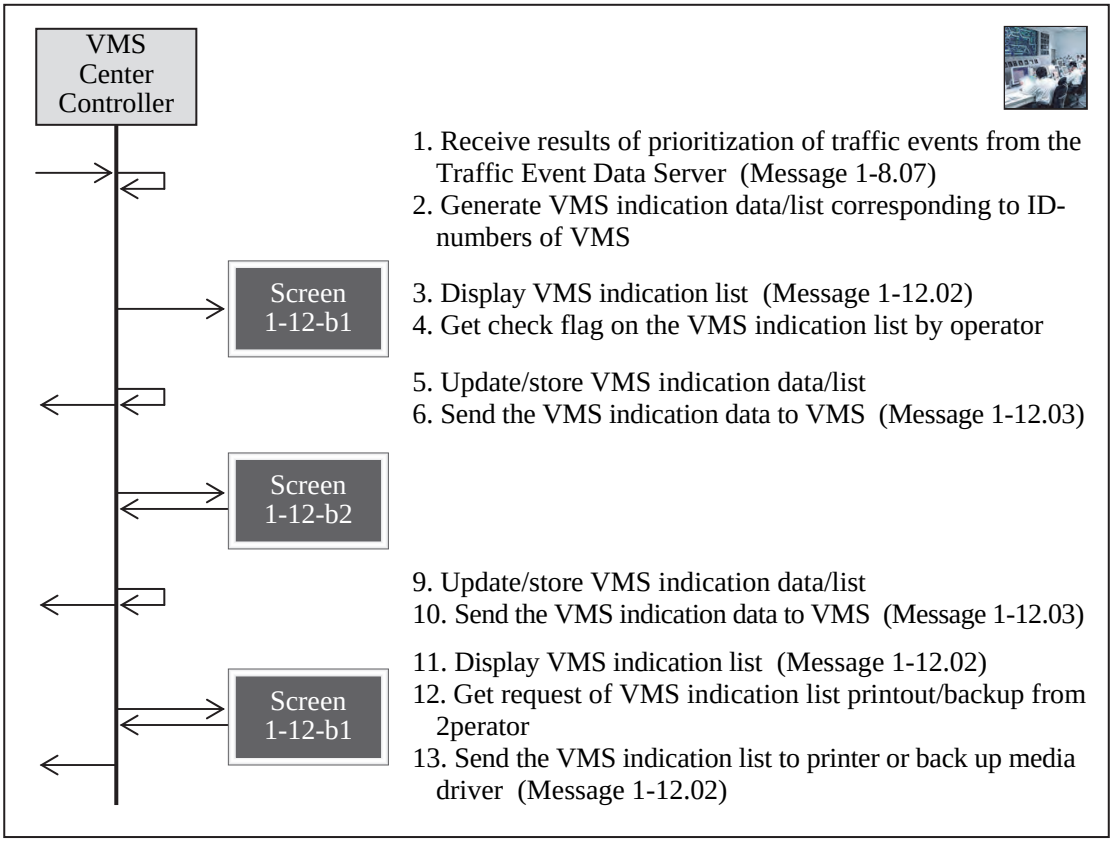
Figure 7.46 Initialization for VMS/CSS Indication



1-12-b Empirical VMS Texts Generation/Check

Displaying and processing in series for showing on each VMS the necessary information as the guidance, upon receiving direct input of the optimum information generated as the results of prioritization of information on the traffic events using the empirical method proven effective for expressway networks.

Figure 7.47 Empirical VMS Texts Generation/Check

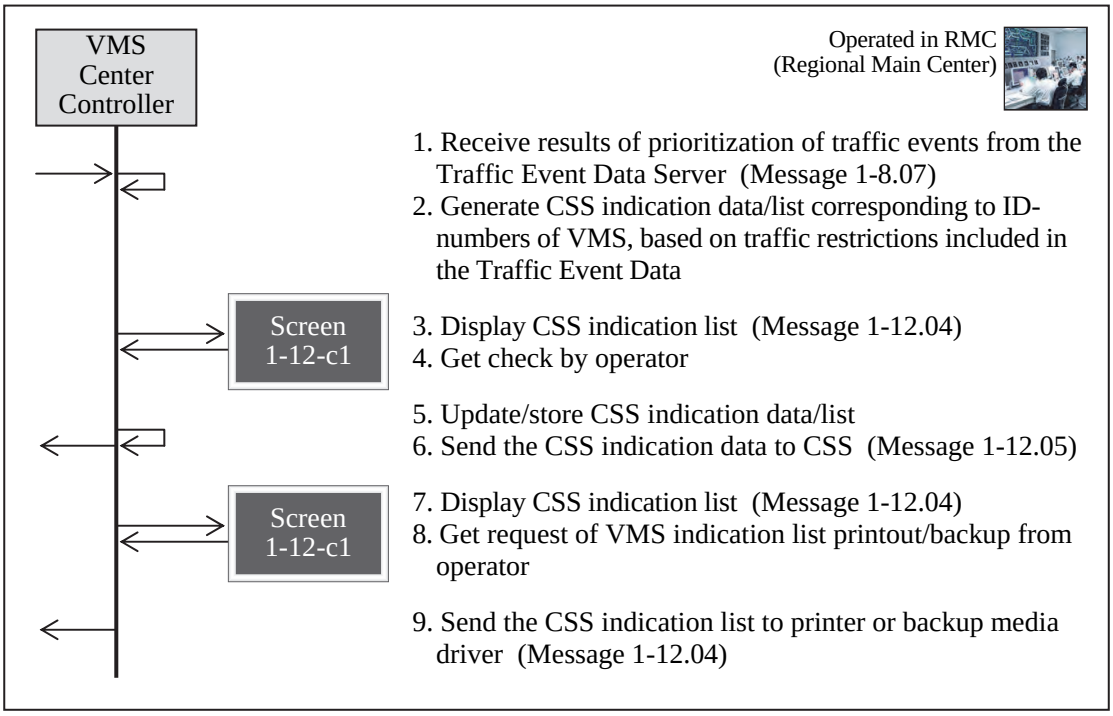


Note: The function of this operation procedure can be executed only in RMC (Regional Main Center).

1-12-c CSS Indication/Check

Displaying and processing in series for confirming/recognizing the speed to be displayed as allocated to each CSS and to display it on CSS, corresponding to the confirmed traffic events.

Figure 7.48 CSS Indication/Check



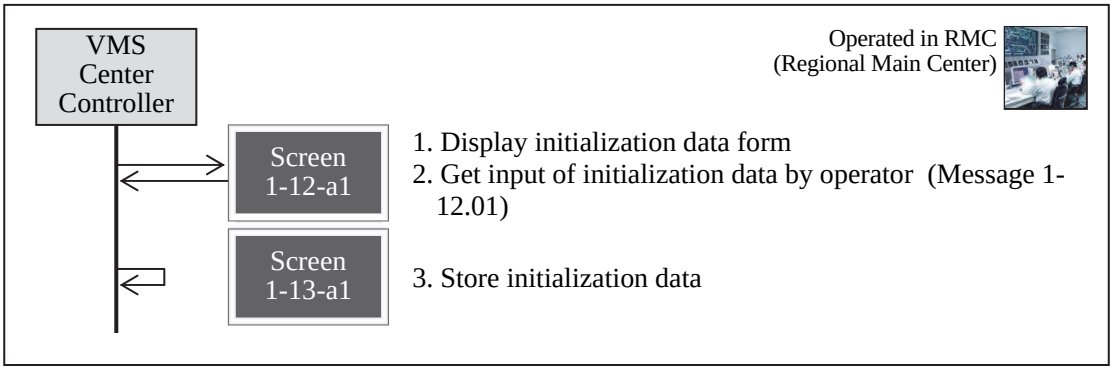
Note: The function of this operation procedure can be executed only in RMC (Regional Main Center).

13) VMS Controller (RMO)

1-13-a Initialization for VMS/CSS Indication

Displaying and processing in series for inputting the initial data required to control the displays on VMS and CSS under its control.

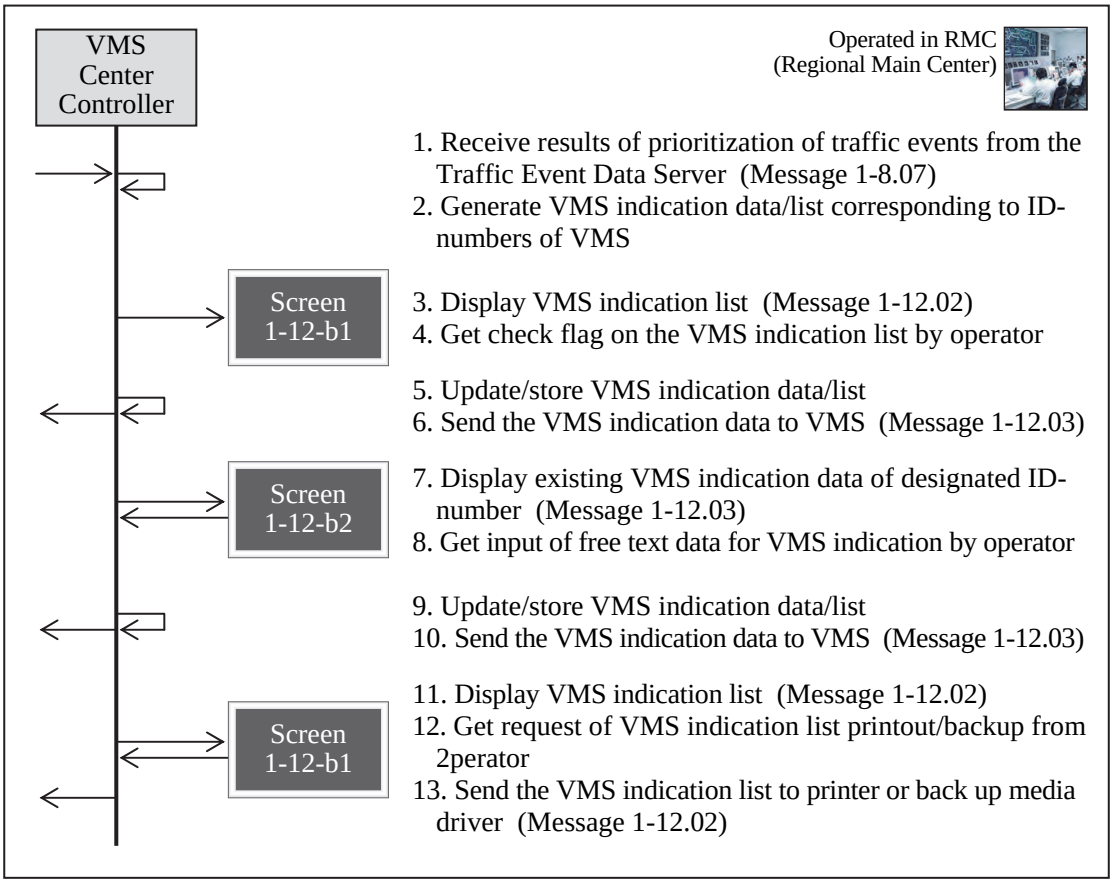
Figure 7.49 Initialization for VMS/CSS Indication



1-13-b Empirical VMS Texts Generation/Check

Displaying and processing in series for showing the information on VMS upon receiving direct input of data corresponding to the displayed guidance.

Figure 7.50 Empirical VMS Texts Generation/Check

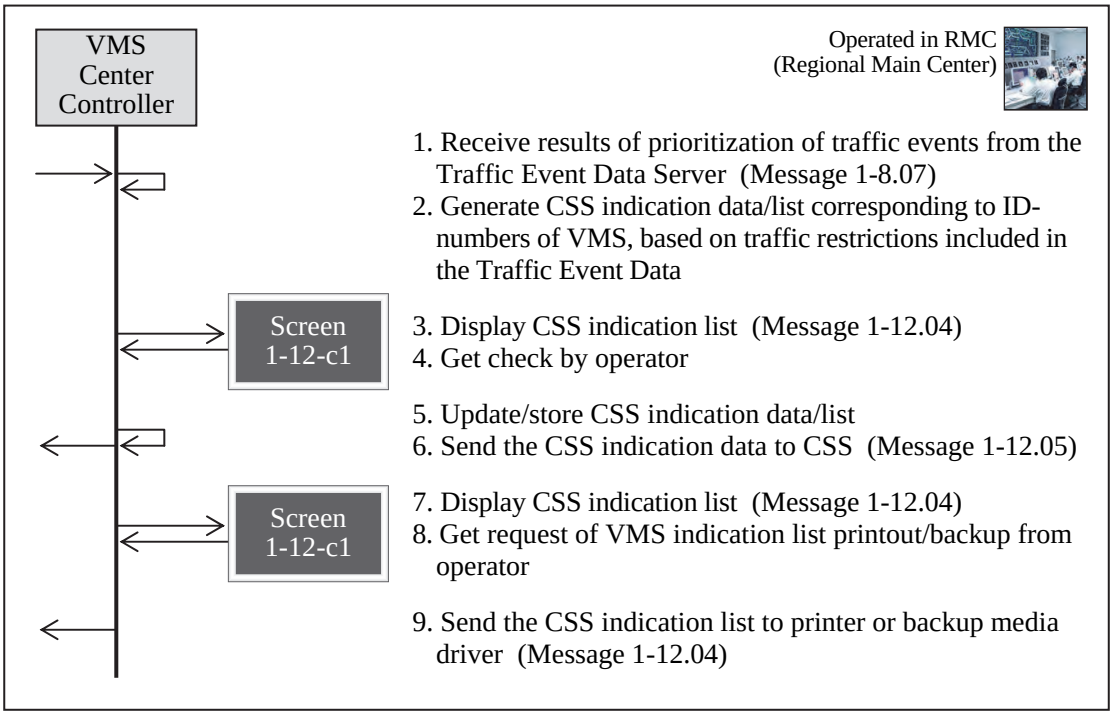


Note: The function of this operation procedure can be executed only in RMC (Regional Main Center).

1-13-c CSS Indication/Check

Displaying and processing in series for confirming/recognizing the speed to be displayed as allocated to each CSS and to display it on CSS, corresponding to the confirmed traffic events.

Figure 7.51 CSS Indication/Check



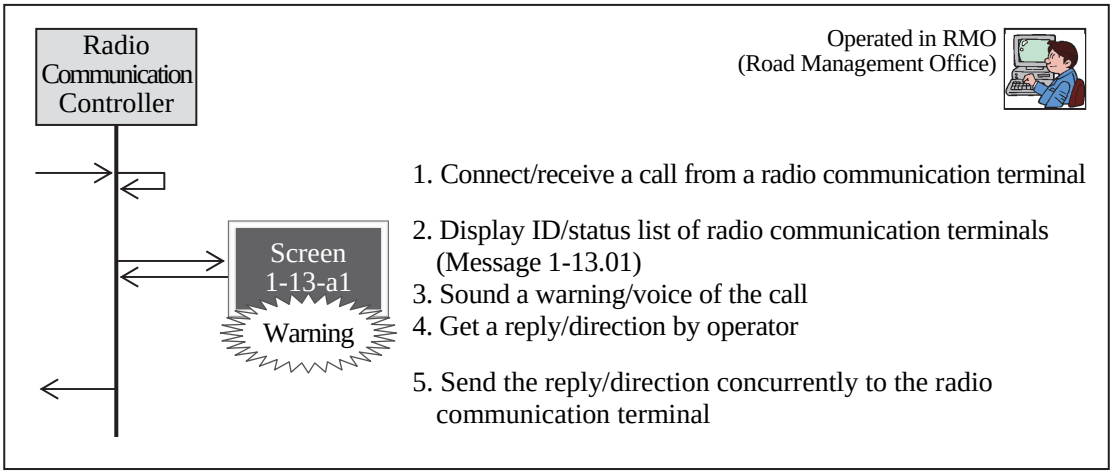
Note: The function of this operation procedure can be executed only in RMC (Regional Main Center).

14) Radio Communication Controller (RMO)

1-14-a Radio Communication Control

Displaying and processing in series for issuing the necessary instructions to the patrol teams, Departments and Sections of RMO involved in the management duties to be implemented or to all related parties at once, and for exchanging the necessary information.

Figure 7.52 Radio Communication Control



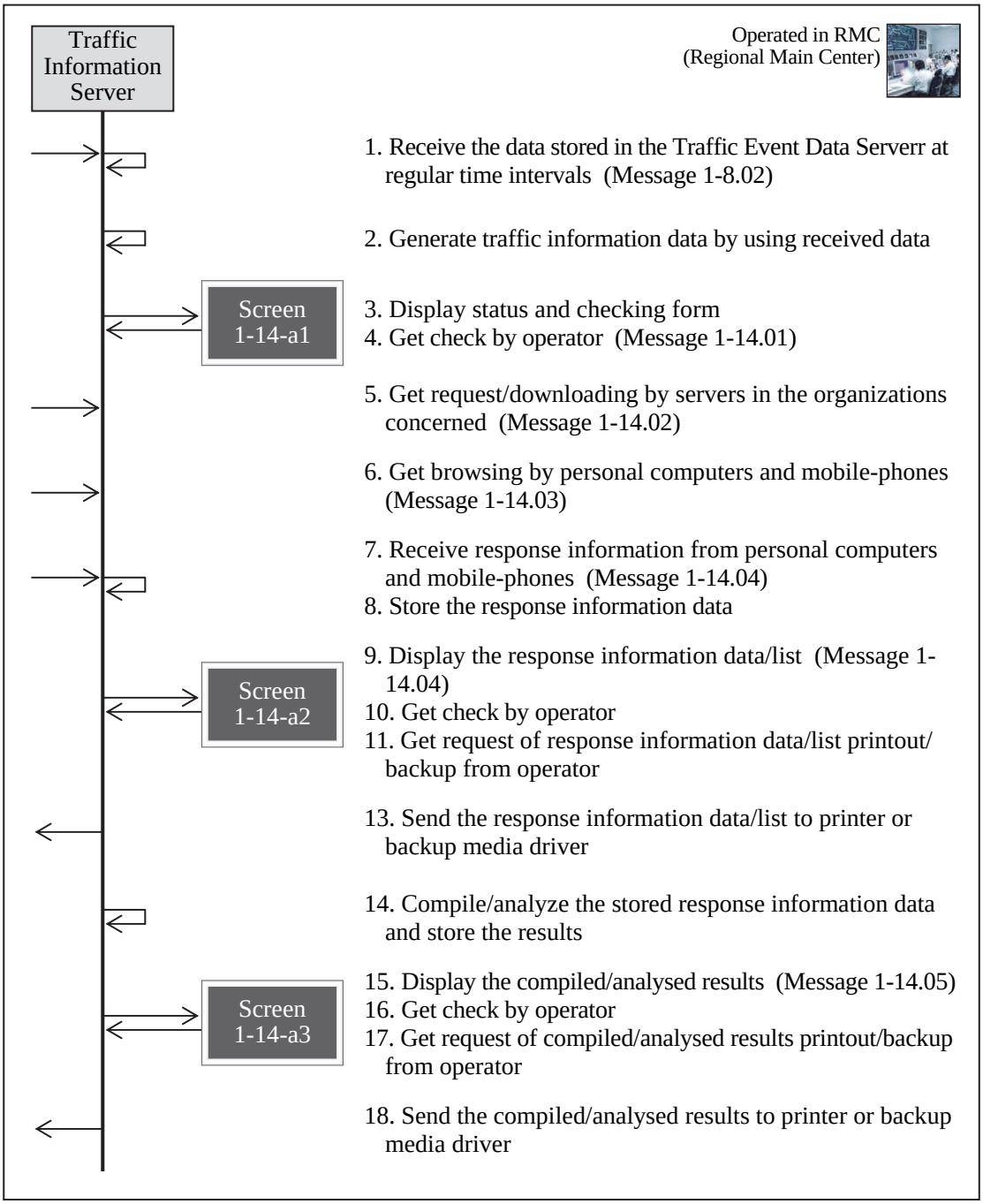
Note: The function of this operation procedure can be executed only in RMO (Road Management Offices).

15) Traffic Information Server (RMC)

1-15-a Traffic Information Generation/Update

Displaying and processing in series for generating, based on the data received from the Traffic Event Data Server, the traffic information to be distributed to the relevant parties via internet, and for confirming, printing and publicizing the results.

Figure 7.53 Traffic Information Generation/Update

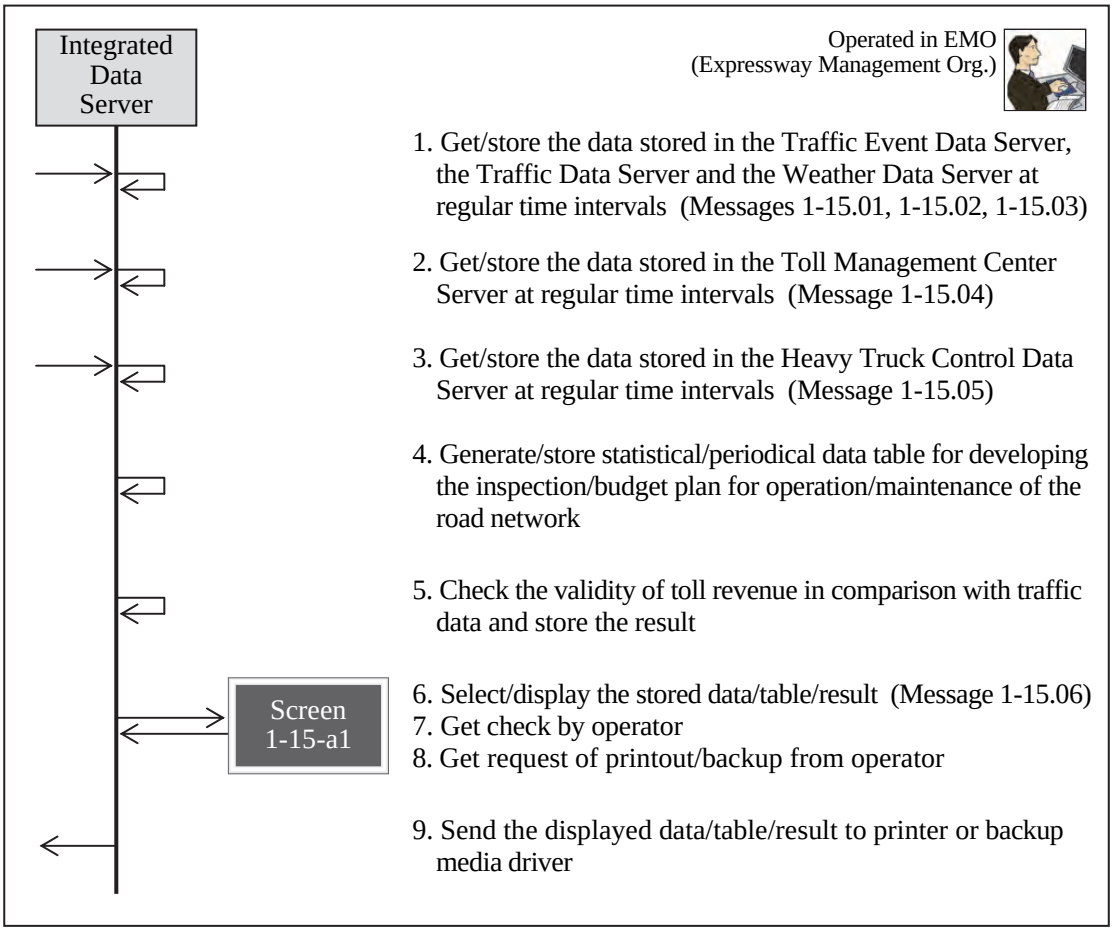


16) Integrated Data Server (VEA)

1-16-a Integrated Data Generation/Update

Displaying and processing in series for editing, confirming and printing the ITS-related data to be integrally saved and managed by MOT.

Figure 7.54 Integrated Data Generation/Update



7.4.2 Major Message List

The major message for traffic information/control system is shown in the list below.

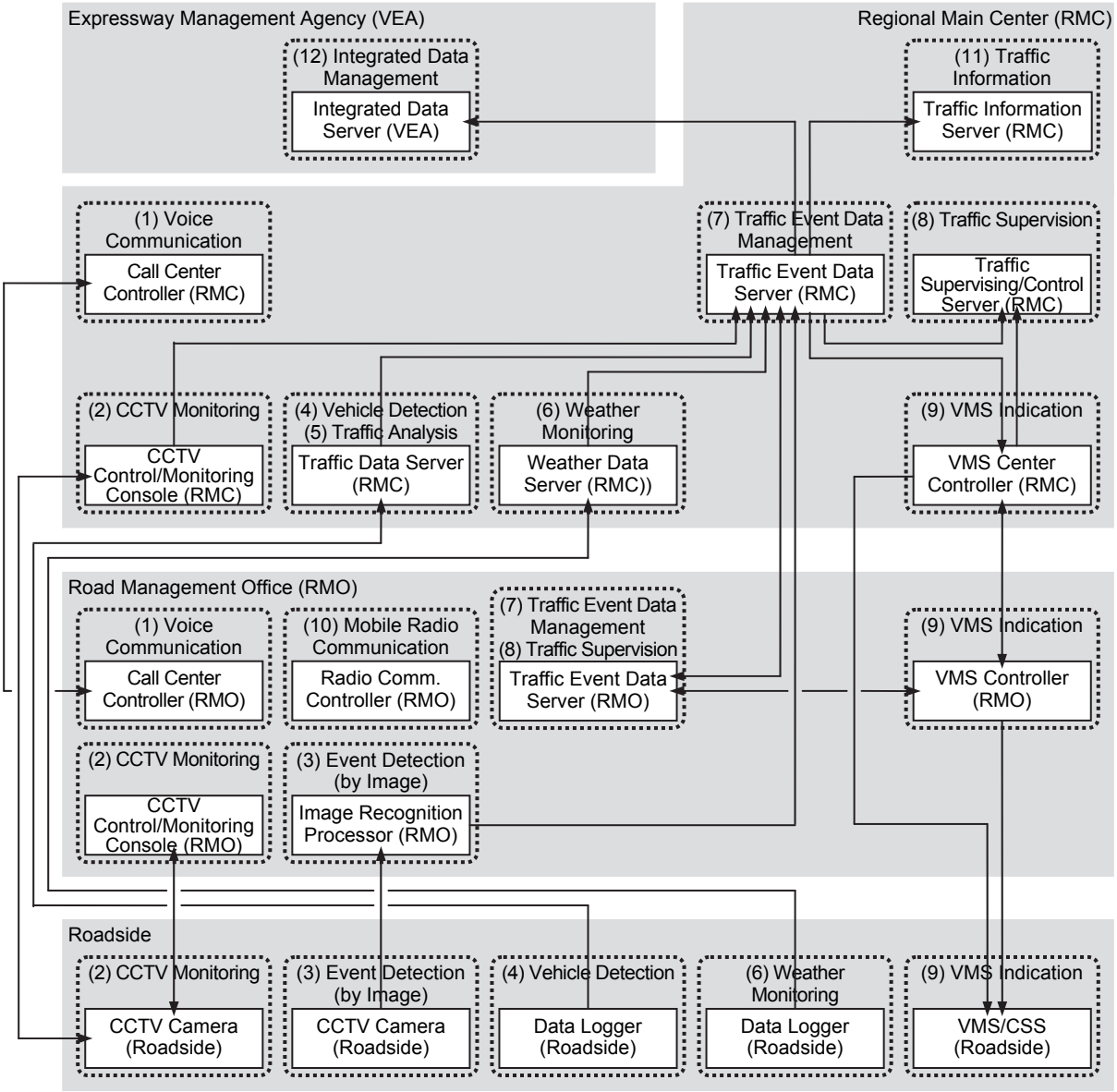
Table 7.4 Major Message List for Traffic Information/Control System

Message	Transmitter (Equipment Component)	Receiver (Equipment Component)	Major Data Sets to be Included
Message 1-1.01	Data Input Device	Call Controller (RMC)	Incident Data Set
Message 1-1.02	Data Input Device	Call Controller (RMC)	Image Recognition Result Data Set
Message 1-3.01	CCTV Control/Monitoring Console (RMC)	CCTV Camera (Roadside)	Vehicle Detection Data Set
	CCTV Control/Monitoring Console (RMO)	CCTV Camera (Roadside)	Traffic Volume Data Set
	CCTV Control/Monitoring Console (RMC)	Traffic Supervising/Control Server (RMC)	Traffic Congestion Data Set
	CCTV Control/Monitoring Console (RMO)	Traffic Supervising/Control Server (RMO)	Traffic Analysis Data Set
	Traffic Supervising/Control Server (RMC)	Main Monitor	Weather Monitoring Dataset
	Traffic Supervising/Control Server (RMO)	Main Monitor	Bad Weather Data Set
Message 1-3.02	CCTV Camera (Roadside)	CCTV Control/Monitoring Console (RMC)	Construction Work Data Set
	CCTV Camera (Roadside)	CCTV Control/Monitoring Console (RMO)	Traffic Restriction Data Set
Message 1-5.01	Data Input Device	Image Recognition Processor (RMO)	Traffic Event Data Set
Message 1-6.01	Data Input Device	Traffic Data Server (RMC)	Event Image Data Set
Message 1-6.02	Data Logger (Roadside)	Traffic Data Server (RMC)	Integrated Data Set
Message 1-6.03	Traffic Data Server (RMC)	Monitor Screen	VMS Check Indication Data Set
Message 1-6.04	Traffic Data Server (RMC)	Monitor Screen	VMS Input/Indication Data Set
	Traffic Data Server (RMC)	Printer, Backup Media Driver	CSS Indication Data Set
Message 1-7.01	Data Input Device	Weather Data Server (RMC)	
Message 1-7.02	Data Logger (Roadside)	Weather Data Server (RMC)	
Message 1-7.03	Weather Data Server (RMC)	Monitor Screen	
Message 1-7.04	Weather Data Server (RMC)	Monitor Screen	
	Weather Data Server (RMC)	Printer, Backup Media Driver	
Message 1-8.01	Data Input Device	Traffic Event Data Server (RMC)	
Message 1-8.02	Traffic Event Data Server (RMC)	Monitor Screen	
	Traffic Event Data Server (RMO)	Monitor Screen	
	Traffic Event Data Server (RMC)	Traffic Supervising/Control Server (RMC)	
	Traffic Event Data Server (RMO)	Traffic Supervising/Control Server (RMO)	
	Traffic Supervising/Control Server (RMC)	Main Monitor	
	Traffic Supervising/Control Server (RMO)	Main Monitor	
	Traffic Event Data Server (RMC)	Traffic Event Data Server (RMO)	
	Traffic Event Data Server (RMC)	Traffic Information Server (RMC)	
	Traffic Event Data Server (RMC))	Printer, Backup Media Driver	
Message 1-8.03	Image Recognition Processor (RMO)	Traffic Event Data Server (RMC)	
Message 1-8.04	Traffic Data Server (RMC)	Traffic Event Data Server (RMC)	
Message 1-8.05	Weather Data Server (RMC)	Traffic Event Data Server (RMC)	
Message 1-8.06	Data Input Device	Traffic Event Data Server (RMC)	
	Data Input Device	Traffic Event Data Server (RMO)	
	Traffic Event Data Server (RMC)	Monitor Screen	
	Traffic Event Data Server (RMO)	Monitor Screen	
	Traffic Event Data Server (RMO)	Traffic Event Data Server (RMC)	
	Traffic Event Data Server (RMC)	Traffic Event Data Server (RMO)	
	Traffic Event Data Server (RMC)	Printer, Backup Media Driver	
Message 1-8.07	Traffic Event Data Server (RMC)	Monitor Screen	
	Traffic Event Data Server (RMC)	VMS Center Controller (RMC)	
Message 1-8.08	Traffic Event Data Server (RMC)	Monitor Screen	
Message 1-8.09	Traffic Event Data Server (RMC)	Monitor Screen	
	Traffic Event Data Server (RMC)	Printer, Backup Media Driver	
Message 1-9.01	Data Input Device	Traffic Event Data Server (RMO)	
Message 1-10.01	Data Input Device	Traffic Supervising/Control Server (RMC)	
Message 1-10.02	Data Input Device	Traffic Supervising/Control Server (RMC)	
	Data Input Device	Traffic Supervising/Control Server (RMO)	
Message 1-10.03	Data Input Device	Traffic Supervising/Control Server (RMC)	
	Data Input Device	Traffic Supervising/Control Server (RMO)	
Message 1-10.04	Data Input Device	Traffic Supervising/Control Server (RMC)	
	Data Input Device	Traffic Supervising/Control Server (RMO)	
Message 1-11.01	Data Input Device	Traffic Event Data Server (RMO)	
Message 1-12.01	Data Input Device	VMS Center Controller (RMC)	
Message 1-12.02	VMS Center Controller (RMC)	Monitor Screen	
	VMS Center Controller (RMC)	Traffic Supervising/Control Server (RMO)	
	VMS Center Controller (RMC)	Traffic Supervising/Control Server (RMO)	
	VMS Center Controller (RMC)	Printer, Backup Media Driver	
Message 1-12.03	VMS Center Controller (RMC)	Monitor Screen	
	VMS Center Controller (RMC)	VMS (Roadside)	

Message 1-12.04	VMS Center Controller (RMC)	Monitor Screen
	VMS Center Controller (RMC)	Printer, Backup Media Driver
Message 1-12.05	VMS Center Controller (RMC)	CSS (Roadside)
Message 1-13.01	Radio Communication Controller (RMO)	Monitor Screen
Message 1-14.01	Data Input Device	Traffic Information Server (RMC)
Message 1-14.02	Traffic Information Server (RMC)	Servers (Organizations Concerned)
Message 1-14.03	Traffic Information Server (RMC)	Mobile Phones (Mobile)
Message 1-14.04	Traffic Information Server (RMC)	Monitor Screen
Message 1-14.05	Traffic Information Server (RMC)	Monitor Screen
Message 1-15.01	Traffic Event Data Server (RMC)	Integrated Data Server (VEA)
Message 1-15.02	Traffic Data Server (RMC)	Integrated Data Server (VEA)
Message 1-15.03	Weather Data Server (RMC)	Integrated Data Server (VEA)
Message 1-15.04	Toll Management Center Server (TMC)	Integrated Data Server (VEA)
Message 1-15.05	Heavy Truck Control Data Server (TO)	Integrated Data Server (VEA)
Message 1-15.06	Integrated Data Server (RMC)	Monitor Screen

Source: ITS Integration Project (SAPI) Study Team

Figure 7.55 Message Exchange among Major Equipment Components



Note, VEA: Expressway Management Agency, RMC: Regional Main center, RMO: Road Management Office.

7.4.3 Primary Data Dictionary

The primary data dictionary for the major data sets of traffic information/control system is shown in the table below.

Table 7.5 Primary Data Dictionary for Traffic Information/Control

	Major Data Set <Origin>	Data Elements	Type	Digit	Set	Update Cycle	Storage Period for Origin	Definition
1	Incident Data Set <I - Server>	Road Management Office ID	INT*	4	1	When an event occurs	1 year	An unique identifier of a road management office
		Road Section ID	INT*	4	1			An unique identifier of the road section where an incident occurred (Jurisdiction of a Road Management Office)
		Lane ID	INT*	2	1			An unique identifier of the lane where an incident occurred (Numbered from the median)
		Place ID	INT*	4	1			An unique identifier of the place where an incident occurred (For information dissemination)
		Beginning Kilometer Post	TXT	6	1			The beginning kilometer post of the place where an incident occurred
		Ending Kilometer Post	TXT	6	1			The ending kilometer post of the place where an incident occurred
		Roadside Equipment ID	INT*	4	1			An unique identifier of a CCTV camera
		Incident Status	INT*	2	1			Class of incident input referring to the video image: - 1: Traffic Accident - 2: Incident in Tunnel - 3: Reverse Driving - 4: Broken-down Vehicle - 5: Left Obstacle - 6: Natural Disaster - 7: Vandalism
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set
2	Image Recognition Result Data Set <G - Image Processor>	Road Management Office ID	INT*	4	1	When an event occurs	Latest	An unique identifier of a road management office
		Roadside Equipment ID	INT*	4	1			An unique identifier of a CCTV camera
		Image Recognition Result Status	INT*	2	1			Status analyzed by image recognition processor (Values are to be proposed by contractor including traffic accidents, breakdown vehicles, left obstacles, reverse driving, vandalism and natural disaster)
		Video Image Address	TXT	60	1			The network address of where the video image file is stored
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set
3	Vehicle Detection Data Set <G - Vehicle Detector>	Road Management Office ID	INT*	4	1	Every 5 minutes	Latest	An unique identifier of a road management office
		Roadside Equipment ID	INT*	4	1			An unique identifier of a CCTV camera
		Cumulative Number of Vehicles	INT*	4	1			Cumulative number of vehicles detected by vehicle detector
		Vehicle Speed	FLOAT	5	N			Vehicle speed detected by vehicle detector (unit: km/h)
		Vehicle Length	FLOAT	4				Vehicle length detected by vehicle detector (unit:: m)
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set
4	Traffic Volume Data Set <G - Traffic Analysis Processor>	Road Management Office ID	INT*	4	1	Every 5 minutes	1 year	An unique identifier of a road management office
		Roadside Equipment ID	INT*	4	1			An unique identifier of a CCTV camera
		Total Traffic Volume per Day	INT	5	1			Total traffic volume per day
		Large Vehicle Ratio	FLOAT	5	1			Percentage of large vehicles to the total number of vehicles
		Traffic Volume per Day of vehicle class 1	INT	5	1			Traffic volume per day vehicle class 1: Ordinary vehicle
		Traffic Volume per Day of vehicle class 2	INT	5	1			Traffic volume per day vehicle class 2: Large vehicle
		Traffic Volume per Day of vehicle class 3	INT	5	1			Traffic volume per day vehicle class 3: Trailer vehicle
		Traffic Volume per Day of vehicle class 4	INT	5	1			Traffic volume per day vehicle class 4: Reserved
		Traffic Volume per Day of vehicle class 5	INT	5	1			Traffic volume per day vehicle class 5: Reserved
		Total Traffic Volume per Hour	INT*	4	1			Total traffic volume in the latest one hour
		Large Vehicle Ratio	FLOAT	5	1			Percentage of large vehicles to the total number of vehicles
		Traffic Volume per Hour of vehicle class 1	INT*	4	1			Traffic volume in the latest one hour of vehicle class 1: Ordinary vehicle
		Traffic Volume per Hour of vehicle class 2	INT*	4	1			Traffic volume in the latest one hour of vehicle class 2: Large vehicle
		Traffic Volume per Hour of vehicle class 3	INT*	4	1			Traffic volume in the latest one hour of vehicle class 3: Trailer vehicle
		Traffic Volume per Hour of vehicle class 4	INT*	4	1			Traffic volume in the latest one hour of vehicle class 4: Reserved
		Traffic Volume per Hour of vehicle class 5	INT*	4	1			Traffic volume in the latest one hour of vehicle class 5: Reserved
		Total Traffic Volume per 15 minutes	INT*	3	1			Total traffic volume in the latest 3 sets of 5 minutes
		Traffic Volume per 15 minutes of vehicle class 1	INT*	3	1			Traffic volume in the latest 3 sets of 5 minutes of vehicle class 1: Ordinary vehicle
		Traffic Volume per 15 minutes of vehicle class 2	INT*	3	1			Traffic volume in the latest 3 sets of 5 minutes of vehicle class 2: Large vehicle
		Traffic Volume per 15 minutes of vehicle class 3	INT*	3	1			Traffic volume in the latest 3 sets of 5 minutes of vehicle class 3: Trailer vehicle
		Traffic Volume per 15 minutes of vehicle class 4	INT*	3	1			Traffic volume in the latest 3 sets of 5 minutes of vehicle class 4: Reserved
		Traffic Volume per 15 minutes of vehicle class 5	INT*	3	1			Traffic volume in the latest 3 sets of 5 minutes of vehicle class 5: Reserved
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set

5	Traffic Congestion Data Set <G - Traffic Analysis Processor>	Road Management Office ID	INT*	4	1	Every 5 minutes	1 year	An unique identifier of a road management office
		Roadside Equipment ID	INT*	4	1			An unique identifier of a CCTV camera
		Cumulative Number of Vehicles	INT*	4	1			Cumulative number of vehicles detected by vehicle detector in the latest 3 sets of 5 minutes
		Average Vehicle Speed	INT*	4	1			Average value of detected vehicle speed in the latest 3 sets of 5 minutes
		Traffic Congestion Status	INT*	2	1			Class of traffic congestion generated referring to the results - 1: Congestion on Trough Lanes 1 - 2: Congestion on Trough Lanes 2 - 3: Congestion on Trough Lanes 3 - 4: Crowdedness on Trough Lanes - 5: Congestion at Exit 1 - 6: Congestion at Exit 2 - 7: Congestion at Exit 3
		Beginning Kilometer Post	TXT	6	1			The beginning kilometer post of vehicle queuing
		Ending Kilometer Post	TXT	6	1			The ending kilometer post of vehicle queuing
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set
6	Weather Monitoring Data Set <G - Weather Sensor>	Road Management Office ID	INT*	4	1	Every 5 minutes	Latest	An unique identifier of a road management office
		Roadside Equipment ID	INT*	4	1			An unique identifier of a weather monitoring device
		Precipitation	FLOAT	2	1			Accumulated precipitation during specific 5 minutes (unit: mm)
		Wind Speed	FLOAT	2	1			Average, minimum, and maximum observed wind speed during specific 5 minutes (unit:: m/s)
		Visibility	FLOAT	2	1			Average, minimum, and maximum observed visibility during specific 5 minutes (unit:: m)
		Temperature	FLOAT	2	1			Average, minimum, and maximum observed temperature during specific 5 minutes (unit:: Celsius degree)
		Alarm Status of Precipitation	INT*	2	1			Alarm to be issued when specific level of precipitation aforementioned is detected
		Alarm Status of Wind Speed	INT*	2	1			Alarm to be issued when specific level of wind speed aforementioned is detected
		Alarm Status of Visibility	INT*	2	1			Alarm to be issued when specific level of visibility aforementioned is detected
		Alarm Status of Temperature	INT*	2	1			Alarm to be issued when specific level of temperature aforementioned is detected
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set
7	Bad Weather Data Set <G - Weather Server>	Road Management Office ID	INT*	4	1	When a bad weather occurs	1 year	An unique identifier of a road management office
		Roadside Equipment ID	INT*	4	1			An unique identifier of a weather monitoring device
		Precipitation	FLOAT	2	1			Precipitation (converted from 10 min. data) measured by rain gauge. (unit:: mm/h)
		Wind Speed	FLOAT	2	1			Wind speed (10 min. average) measured by wind sensor (unit:: m/s)
		Visibility	FLOAT	2	1			Visibility (10 min. average) measured by visibility sensor (unit:: m)
		Temperature	FLOAT	2	1			Temperature (10 min. average) measured by thermometer (unit: Celsius degree)
		Heavy Rain Status	INT*	2	1			Specifying bad weather in traffic event category and corresponding class of heavy rain in traffic event class: - 1: Heavy Rain 1 - 2: Heavy Rain 2 - 3: Heavy Rain 3
		High Wind Status	INT*	2	1			Specifying bad weather in traffic event category and corresponding class of high wind in traffic event class: - 1: High Wind 1 - 2: High Wind 2 - 3: High Wind 3
		Low Visibility Status	INT*	2	1			Specifying bad weather in traffic event category and corresponding class of lowering of visibility in traffic event class: - 1: Dense Fog 1 - 2: Dense Fog 2 - 3: Dense Fog 3
		High Temperature Status	INT*	2	1			Specifying bad weather in traffic event category and corresponding class of high temperature in traffic event class: - 1: High Temperature
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set
8	Construction Work Data Set <I - Server>	Road Management Office ID	INT*	4	1	When a construction work is scheduled	1 year after end of construction	An unique identifier of a road management office
		Road Section ID	INT*	4	1			An unique identifier of the road section where a construction work applied (Jurisdiction of a Road Management Office)
		Lane ID	INT*	2	1			An unique identifier of the lane where a construction work applied (Numbered from the median)
		Place ID	INT*	4	1			An unique identifier of the place where a construction work applied (For information dissemination)
		Beginning Kilometer Post	TXT	6	1			The beginning kilometer post of the place where a construction work applied
		Ending Kilometer Post	TXT	6	1			The ending kilometer post of the place where a construction work applied
		Construction Work Status	INT*	2	1			Status of construction work: - 1: Scheduled - 2: Under construction - 3: Finished
		Number of document	TXT	20	1			Official number of permission document
		Permission Date	TXT	8	1			The date (Day/month/year) of permission of construction work
		Date/Time Begin	TXT	≥14	1			The begin time (Day/month/year/hour/minutes/second) of construction work
		Date/Time End	TXT	≥14	1			The end time (Day/month/year/hour/minutes/second) of construction work
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set

9	Traffic Restriction Data Set <I - Server>	Road Management Office ID	INT*	4	1	When an event occurs	1 year after end of restriction	An unique identifier of a road management office
		Road Section ID	INT*	4	1			An unique identifier of the road section where a construction work applied (Jurisdiction of a Road Management Office)
		Lane ID	INT*	2	1			An unique identifier of the lane where a construction work applied (Numbered from the median)
		Place ID	INT*	4	1			An unique identifier of the place where a construction work applied (For information dissemination)
		Beginning Kilometer Post	TXT	6	1			The beginning kilometer post of the place where a traffic restriction applied
		Ending Kilometer Post	TXT	6	1			The ending kilometer post of the place where a traffic restriction applied
		Construction Work Status	INT*	2	1			Status of construction work: - 1: Scheduled - 2: Under construction - 3: Finished
		Permission Date	TXT	8	1			The date (Day/month/year) of permission of traffic restriction
		Date/Time Begin	TXT	≥14	1			The begin time (Day/month/year/hour/minutes/second) of traffic restriction
		Date/Time End	TXT	≥14	1			The end time (Day/month/year/hour/minutes/second) of traffic restriction
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set
10	Traffic Event Data Set <G/C - Server>	Traffic Event Data ID	INT	8	1	When an event occurs	1 year	An unique identifier of the traffic event data
		Road Management Office ID	INT*	4	1			An unique identifier of a road management office
		Road Section ID	INT*	4	1			An unique identifier of the road section where a traffic event occurred (Jurisdiction of a Road Management Office)
		Road Link ID	INT*	4	1			An unique identifier of a segmentation of road network divided by diverging/ merging points at interchanges/ junctions or barrier tollgates
		Lane ID	INT*	2	1			An unique identifier of the lane where a traffic event occurred (Numbered from the median)
		Place ID	INT*	4	1			An unique identifier of the place where a traffic event occurred (For information dissemination)
		Traffic Event Category ID	INT*	4	1			An unique identifier of traffic event data category: - 1: Special Event - 2: Incident - 3: Construction Work - 4: Bad Weather - 5: Traffic Congestion - 6: Traffic - 7: Restriction
		Traffic Event Class ID	INT*	4	1			An unique identifier of traffic event data class 01: Special Event 19: High Temperature 02: Traffic Accident 20: Congestion on Trough Lanes 1 03: Incident in Tunnel 21: Congestion on Trough Lanes 2 04: Reverse Driving 22: Congestion on Trough Lanes 3 05: Broken-down Vehicle 23: Crowdedness on Trough Lanes 06: Left Obstacle 24: Congestion at Exit 1 07: Natural Disaster 25: Congestion at Exit 2 08: Vandalism 26: Congestion at Exit 3 09: Construction Work 27: Entry Closure 10: Heavy Rain 1 28: Closure 11: Heavy Rain 2 29: Exit Closure 12: Heavy Rain 3 30: Lane Closure 13: High Wind 1 31: Speed Limitation 1 14: High Wind 2 32: Speed Limitation 2 15: High Wind 3 16: Dense Fog 1 17: Dense Fog 2 18: Dense Fog 3
		Causal Traffic Event Data ID	INT	8	1			An unique identifier of the causal traffic event data
		Beginning Kilometer Post	TXT	6	1			The beginning kilometer post of the place where a traffic event occurred
		Ending Kilometer Post	TXT	6	1			The ending kilometer post of the place where a traffic event occurred
		Input Person	TXT	32	1			Name of the person who input traffic event data set
		Event Status	TXT	4	1			Status of traffic event
		Video Image address	TXT	60	1			The network address of where the Video image file is stored
		Main Center Check Status	INT*	4	1			Approval status by the main center: - 0: Not yet approved - 1: Approved
		Road Management Office Check Status	INT*	4	1			Approval status by the road management office: - 0: Not yet approved - 1: Approved
		Status of Traffic Event	INT*	2	1			Status of traffic event: - 1: Occurred and existing - 2: Removed
		Date/Time End	TXT	≥14	1			Day/month/year/hour/minutes/second of the traffic event input by operator
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set
11	Event Image Data Set <G - Server>	Road Management Office ID	INT*	4	1	When an event is checked	1 year	An unique identifier of a road management office
		Roadside Equipment ID	INT*	4	1			An unique identifier of a CCTV camera
		Place ID	INT*	4	1			An unique identifier of the place where the traffic event occurred (For information dissemination)
		Video Image ID	INT	8	1			An unique identifier of the video image
		Event Video Image	IMG	var	1			Video image data during time interval from 5 min before incident to 10 min after incident
		Traffic Event Data ID	INT	8	1			An unique identifier of the traffic event data
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set

12	Integrated Data Set <G -Server>	Date/Time	TXT	≥14	1	Every 1 hour	1 year	Date and time for the reference of a data set
		Road Section ID	INT*	4	1			An unique identifier for the reference of a data set (Jurisdiction of a Road Management Office)
		Kilometer Post	TXT	6	1			Kilometer post for the reference of a data set
		Lane ID	INT*	2	1			An unique identifier of the lane for the reference of a data set (Numbered from the median)
		Data Set ID	INT*	2	1			An unique identifier of the kind for the reference of a data set - 1: Incident Data Set - 2: Traffic Volume Data Set - 3: Traffic Congestion Data Set - 4: Bad Weather Data Set - 5: Construction Work Data Set - 6: Traffic Restriction Data Set - 7: Traffic Event Data Set - 8: Hourly Toll Collection Data Set - 9: Axle Load Management Data Set
		Data Set	Set	var	1			A data set corresponding to Date/time, Road Section ID, Kilometer Post, Lane ID and Data Set ID
13	VMS Check /Indication Data Set <G/C - Server>	Road Management Office ID	INT*	4	1	When an event occurs	1 month	An unique identifier of a road management office
		Roadside Equipment ID	INT*	4	1			An unique identifier of a VMS
		Traffic Event Class ID	INT*	4	1			An unique identifier of the traffic event class
		Place ID	INT*	4	1			An unique identifier of the place where a traffic event occurred (For information dissemination)
		Place Name	TXT	28	1			Name of the place where a traffic event occurred
		Traffic Event ID	INT	8	1			An unique identifier of the traffic event (including indication of "Under Repair")
		Traffic Event Name	TXT	20	1			Name of the traffic event occurred
		Causal Place ID	INT*	4	1			An unique identifier of the place where the causal traffic event occurred (For information dissemination)
		Causal Place Name	TXT	28	1			Name of the place where the causal traffic event occurred
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set
14	VMS Input/Indication Data Set <I - Server>	Road Management Office ID	INT*	4	1	When an event occurs	1 month	An unique identifier of a road management office
		Roadside Equipment ID	INT*	4	1			An unique identifier of a VMS
		Traffic Event Class ID	INT*	4	1			An unique identifier of the traffic event class
		Place ID	INT*	4	1			An unique identifier of the place where a traffic event occurred (For information dissemination)
		Place Name	TXT	28	1			Name of the place where a traffic event occurred
		Traffic Event ID	INT	8	1			An unique identifier of the traffic event (including indication of "Under Repair")
		Traffic Event Name	TXT	20	1			Name of the traffic event occurred
		Causal Place ID	INT*	4	1			An unique identifier of the place where the causal traffic event occurred (For information dissemination)
		Causal Place Name	TXT	28	1			Name of the place where the causal traffic event occurred
		Free Text	TXT	var	1			The characters input using data input device
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set
15	CSS Indication Data Set <G/C - Server>	Road Management Office ID	INT*	4	1	When an event occurs	1 month	An unique identifier of a road management office
		Roadside Equipment ID	INT*	4	1			An unique identifier of a CSS
		Speed Limit	INT*	3	1			The limit speed input using data input device
		Date/Time	Datetime	≥14	1			Year/month/day /hour/minutes/second of generating data set

Note: IMG: Image, TXT: Text, FLOAT: Floating-point complex number, INT: Integer, INT*: Short integer, I: Input, G: Generated, C: Checked, R: Recorded.

Source: The Study Team

7.5 Toll Collection/Management System (For Reference)

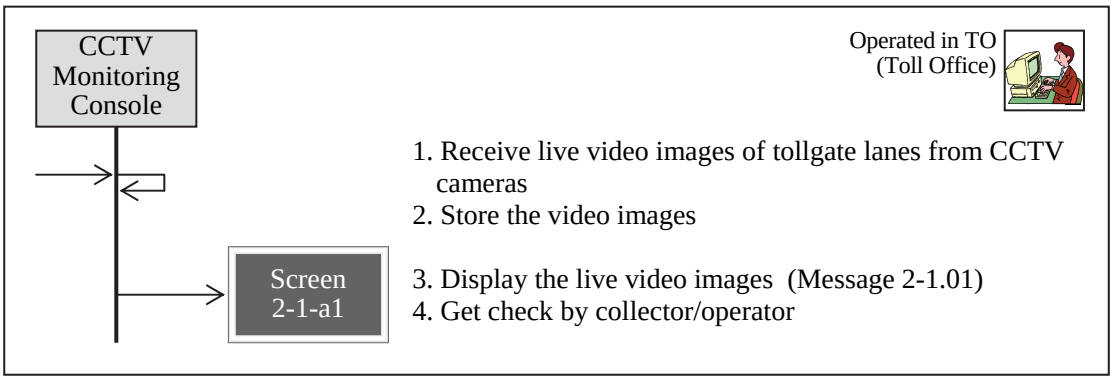
7.5.1 Processing/Screen Transition Diagrams

1) CCTV Monitoring Console (TO)

2-1-a Tollgate Lane Monitoring

Displaying and processing in series for confirming, by CCTV Cameras, the conditions of vehicle passages and toll collecting activities at each tollgate lane.

Figure 7.56 Tollgate Lane Monitoring

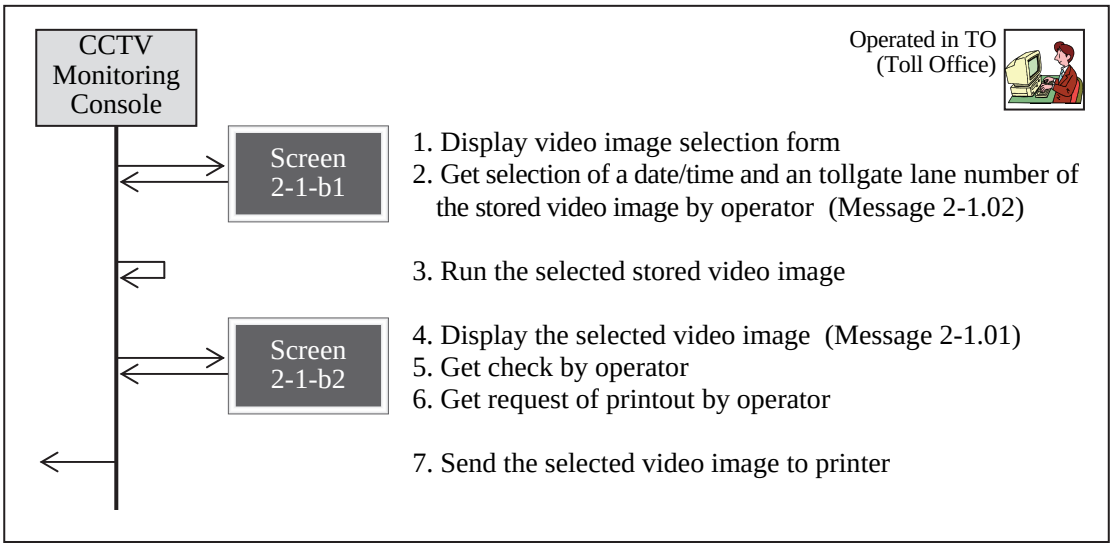


Note: The video image is to be stored/displayed together with the indication from the Lane Server.

2-1-b Video Record Check

Displaying and processing in series for checking monthly the recorded images to find the unlawful passage vehicles and for printing the documents for submission to the police.

Figure 7.57 Video Record Check



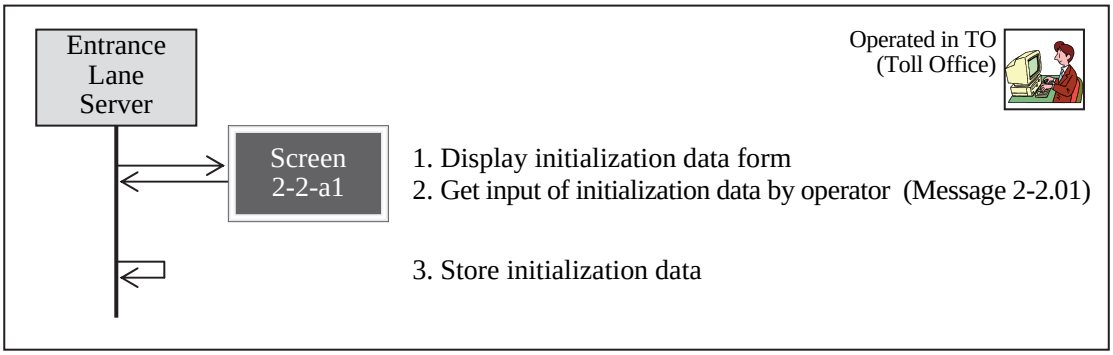
Note: The video image is to be stored/displayed together with the indication from the Lane Server.

2) Lane Server (TO)

2-2-a Initialization for Lane Control

Displaying and processing in series for inputting the initial data required for lane control, vehicle class identification and toll calculation at each tollgate lane.

Figure 7.58 Initialization for Lane Control

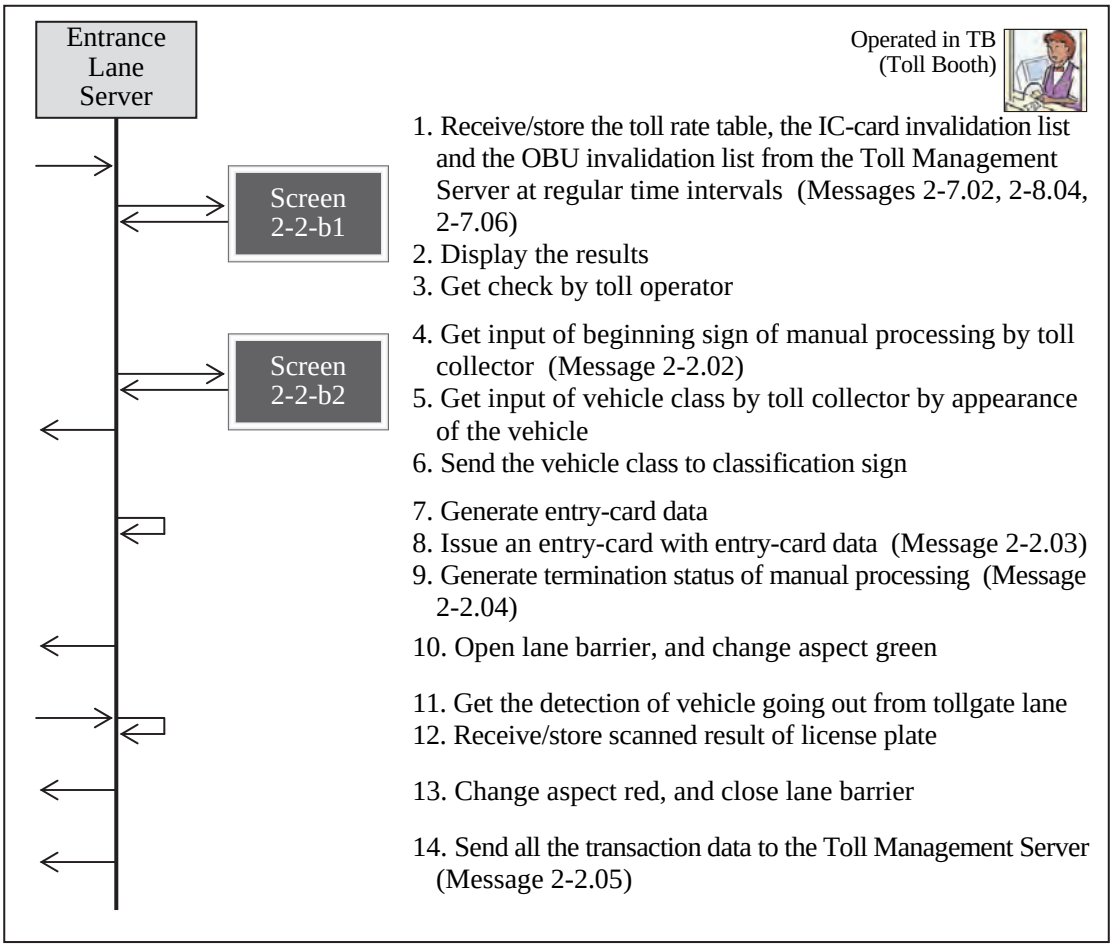


Note: This operation procedure is necessary also for other Lane Servers.

2-2-b Manual Procedure for Entrance

Displaying and processing in series for conducting manual toll collection at the entry tollgate and for indicating any key data and errors to the tollgate personnel.

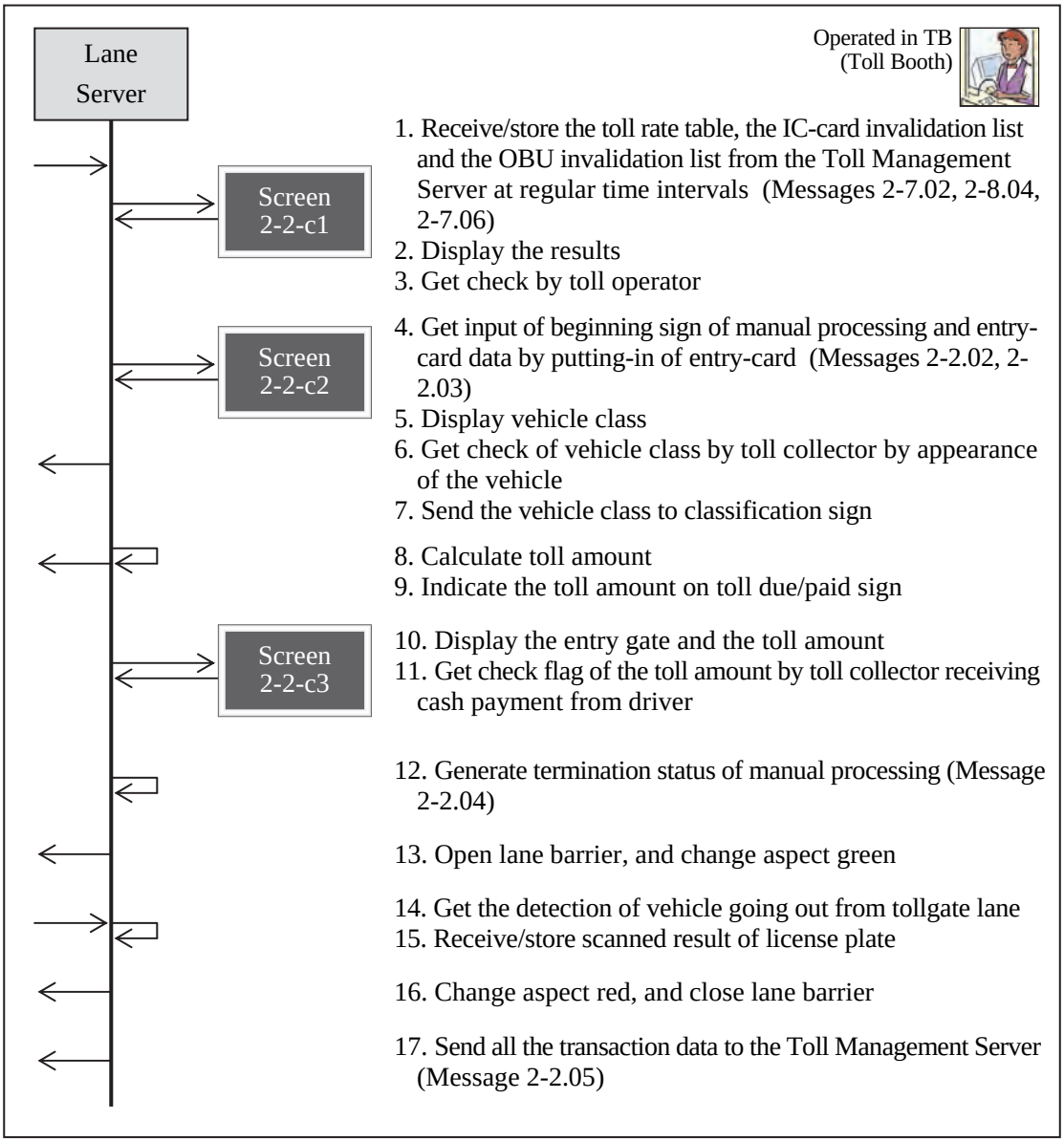
Figure 7.59 Manual Procedure for Entrance



2-2-c Manual Procedure for Exit/Flat-tariff

Displaying and processing in series for conducting manual toll collection at the exit or flat-tariff tollgate and for indicating any key data and errors to the tollgate personnel.

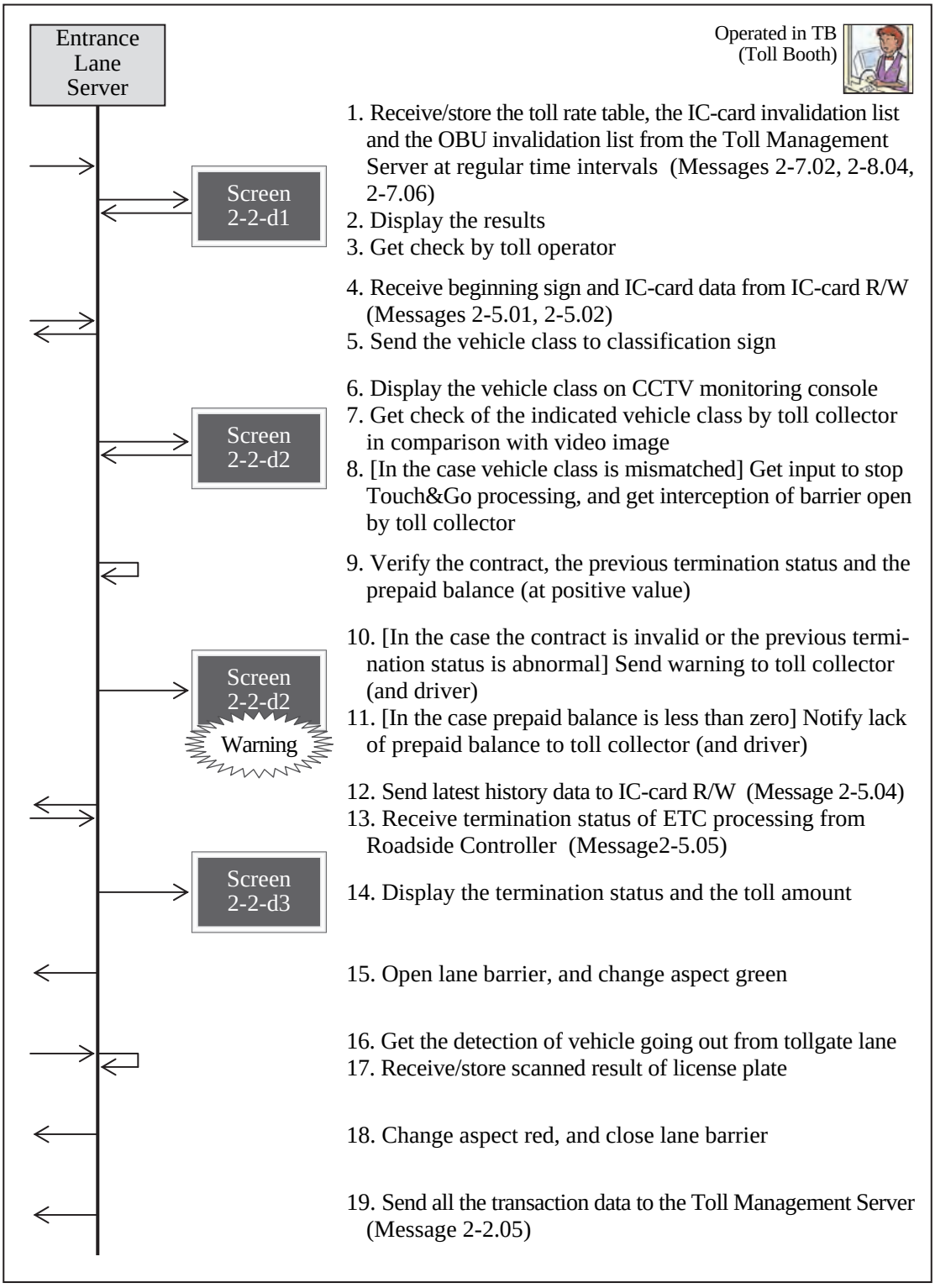
Figure 7.60 Manual Procedure for Exit/Flat-tariff



2-2-d Touch&Go Procedure for Entrance

Displaying and processing in series for conducting toll collection by Touch&go at the entry tollgate and for indicating any key data and errors to the tollgate personnel.

Figure 7.61 Touch&Go Procedure for Entrance

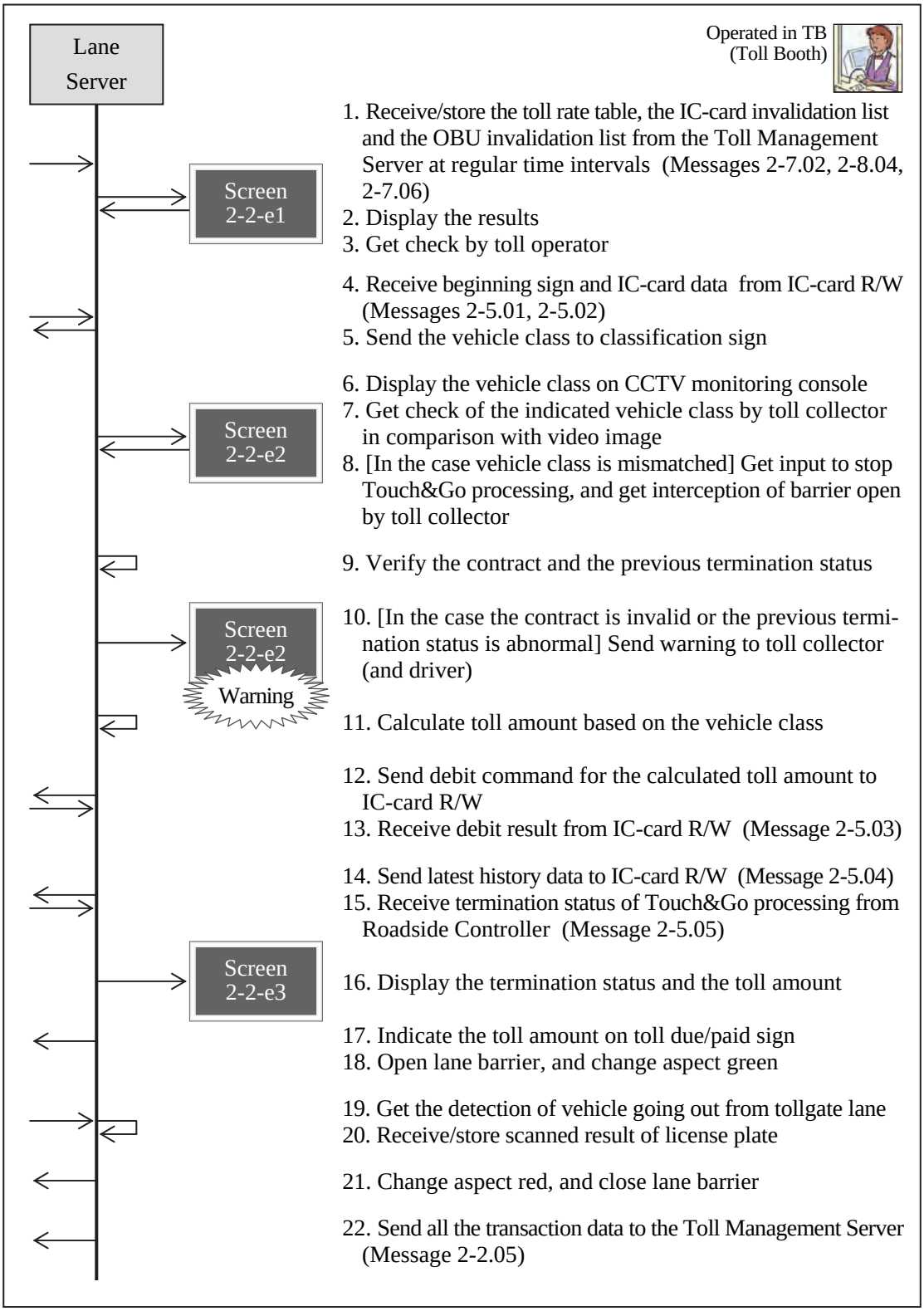


Note: This operation procedure can be achieved based on a single vehicle class data for a IC-card.

2-2-e Touch&Go Procedure for Exit/Flat-tariff

Displaying and processing in series for conducting toll collection by Touch&go at the exit or flat-tariff tollgate and for indicating any key data and errors to the tollgate personnel.

Figure 7.62 Touch&Go Procedure for Exit/Flat-tariff

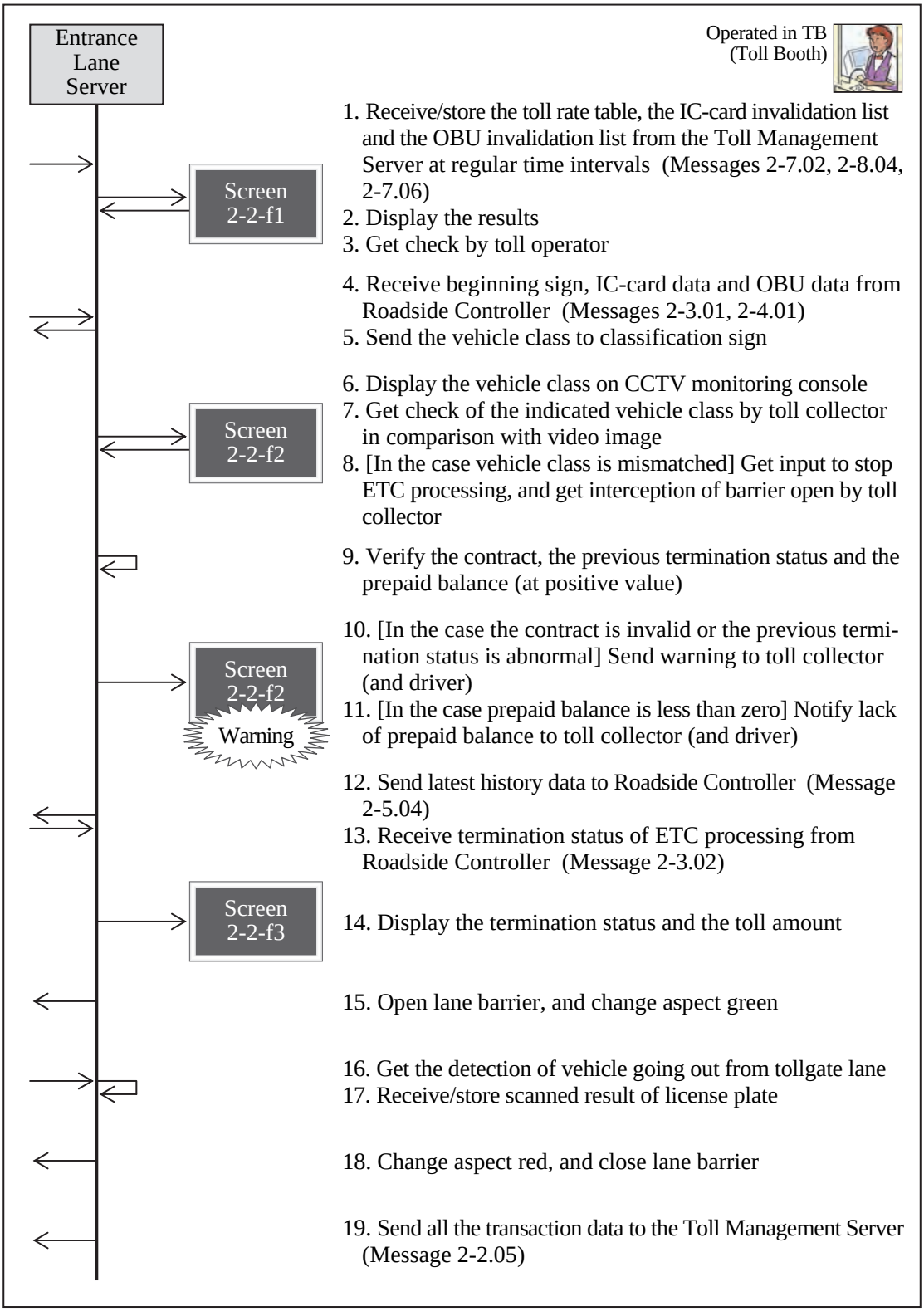


Note: This operation procedure can be achieved based on a single vehicle class data for a IC-card.

2-2-f ETC Procedure for Entrance

Displaying and processing in series for conducting toll collection by ETC at the entry tollgate and for indicating any key data and errors to the tollgate personnel.

Figure 7.63 ETC Procedure for Entrance

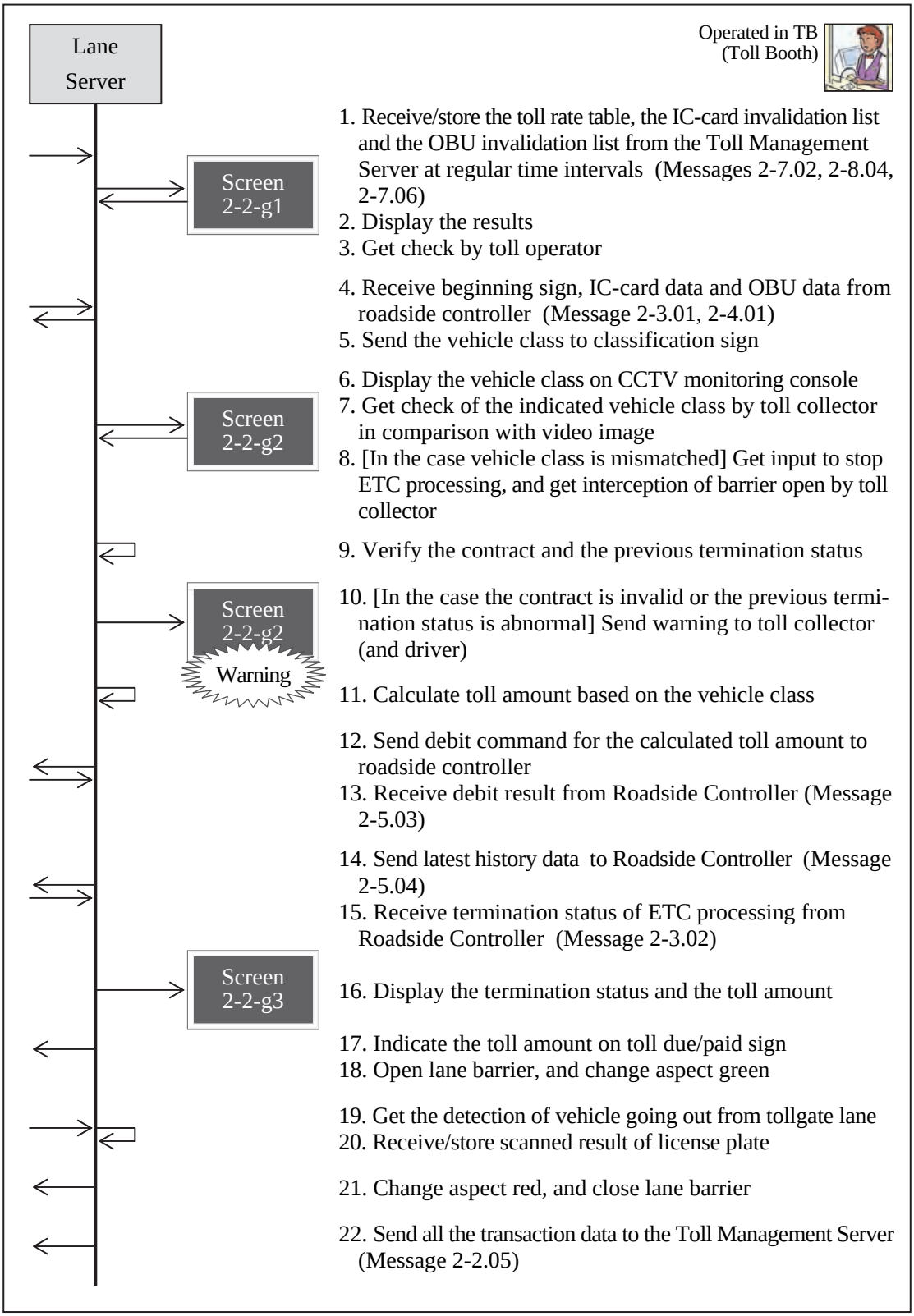


Note: This operation procedure can be achieved based on a single vehicle class data for a IC-card.

2-2-g ETC Procedure for Exit/Flat-tariff

Displaying and processing in series for conducting toll collection by ETC at the exit or flat-tariff tollgate and for indicating any key data and errors to the tollgate personnel.

Figure 7.64 ETC Procedure for Exit/Flat-tariff



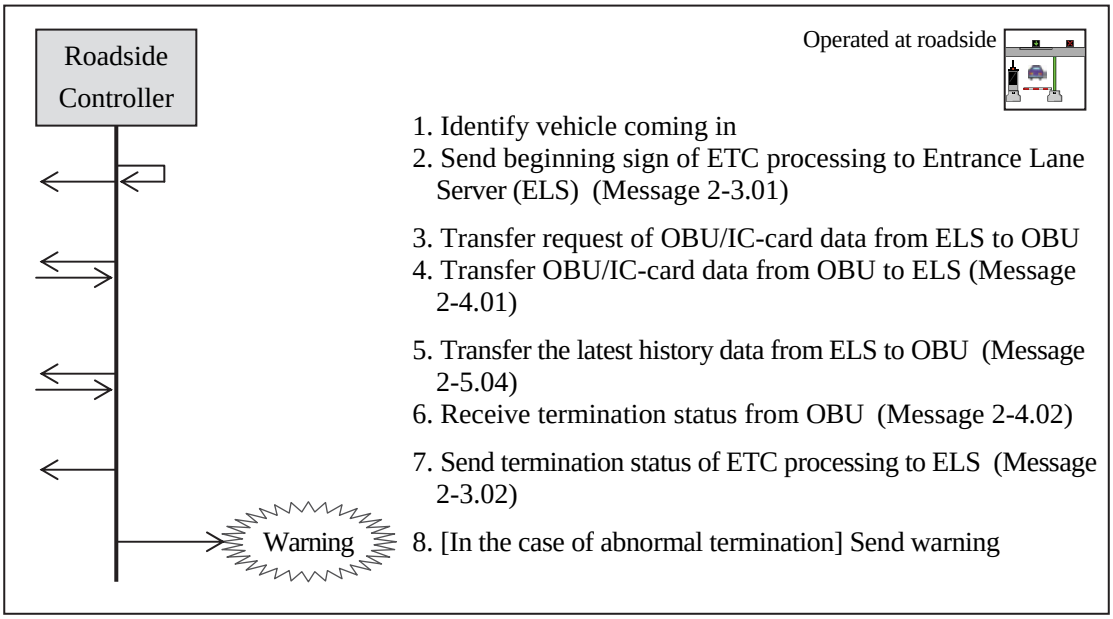
Note: This operation procedure can be achieved based on a single vehicle class data for a IC-card.

3) Roadside Controller (Roadside)

2-3-a Road-to-Vehicle Communication Check for Entrance

Displaying for conducting road-to-vehicle communication for ETC at the entry tollgate and for indicating any errors.

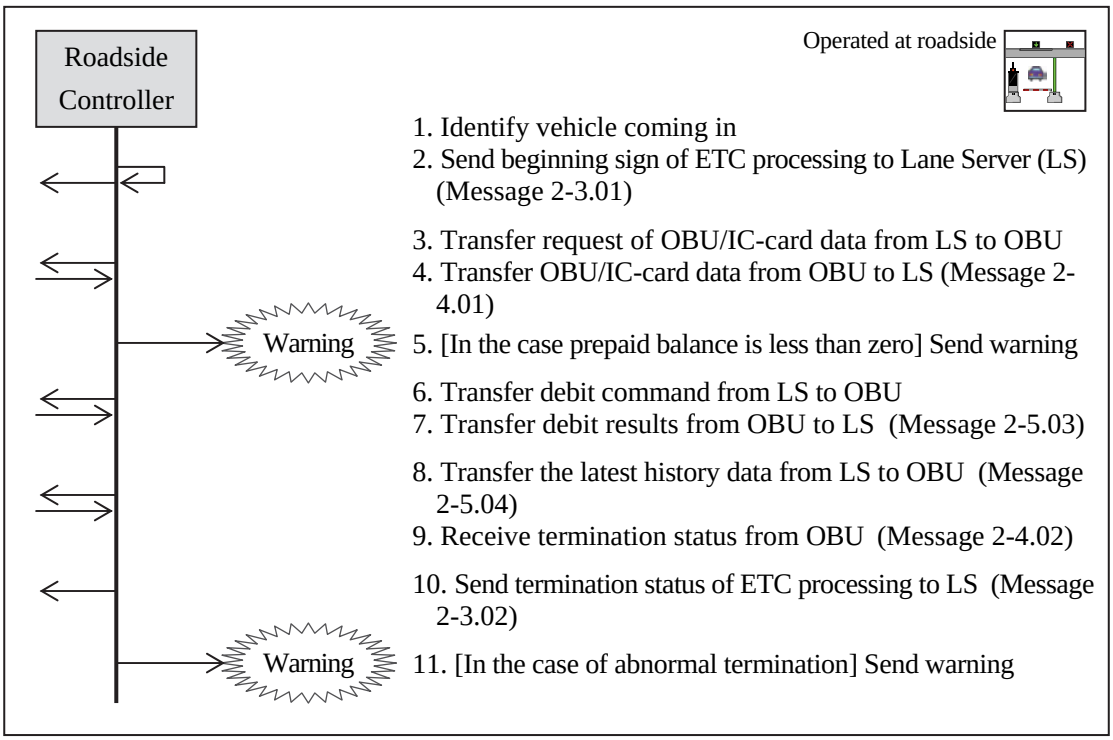
Figure 7.65 Road-to-Vehicle Communication Check for Entrance



2-3-b Road-to-Vehicle Communication Check for Exit/Flat-tariff

Displaying for conducting road-to-vehicle communication for ETC at the exit or flat-tariff tollgate and for indicating any errors.

Figure 7.66 Road-to-Vehicle Communication Check for Exit/Flat-tariff

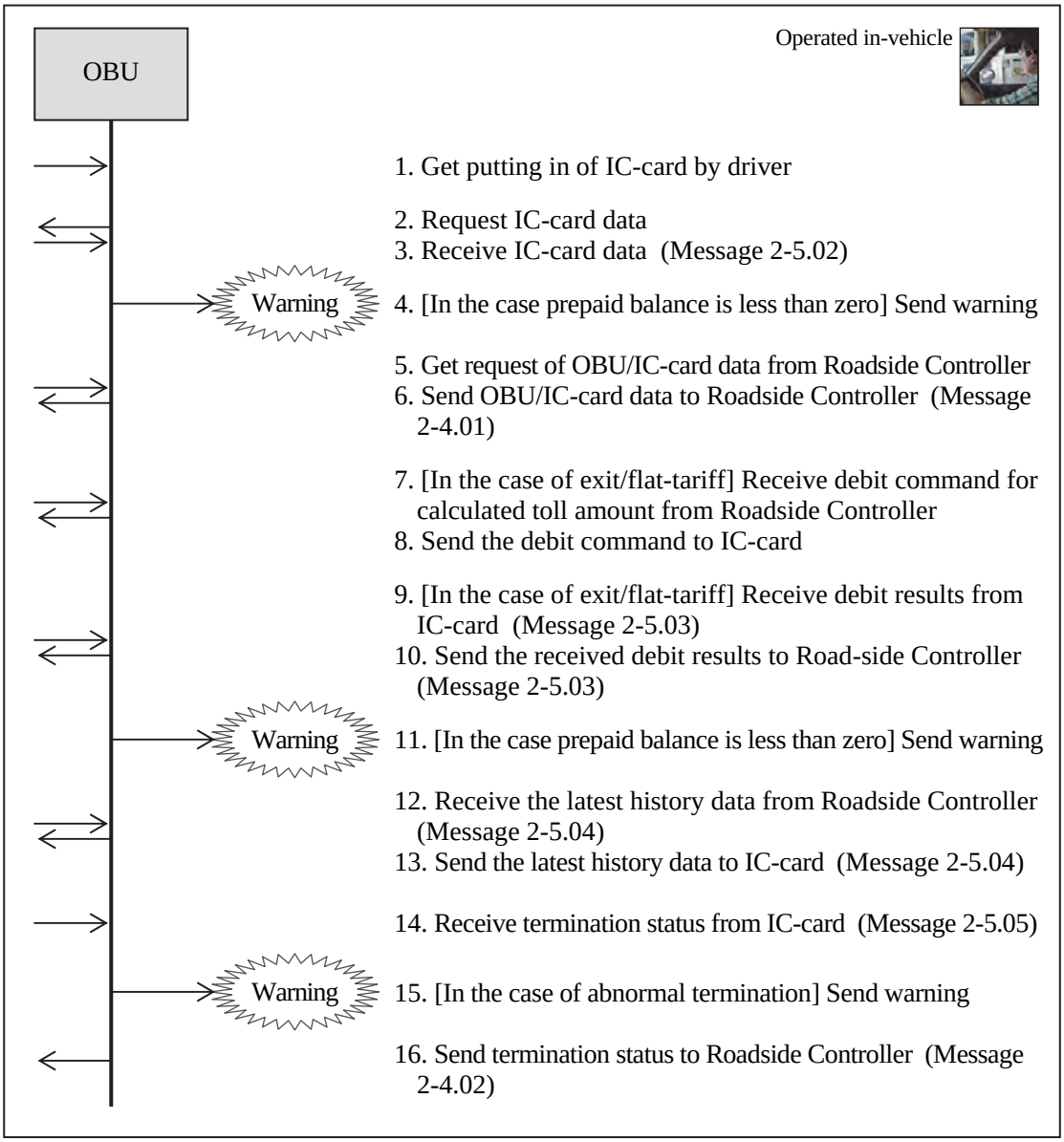


4) OBU (In-vehicle)

2-4-a Road-to-Vehicle Communication Check by OBU

Displaying for conducting road-to-vehicle communication for ETC and indicating any errors on OBU.

Figure 7.67 Road-to-Vehicle Communication Check by OBU

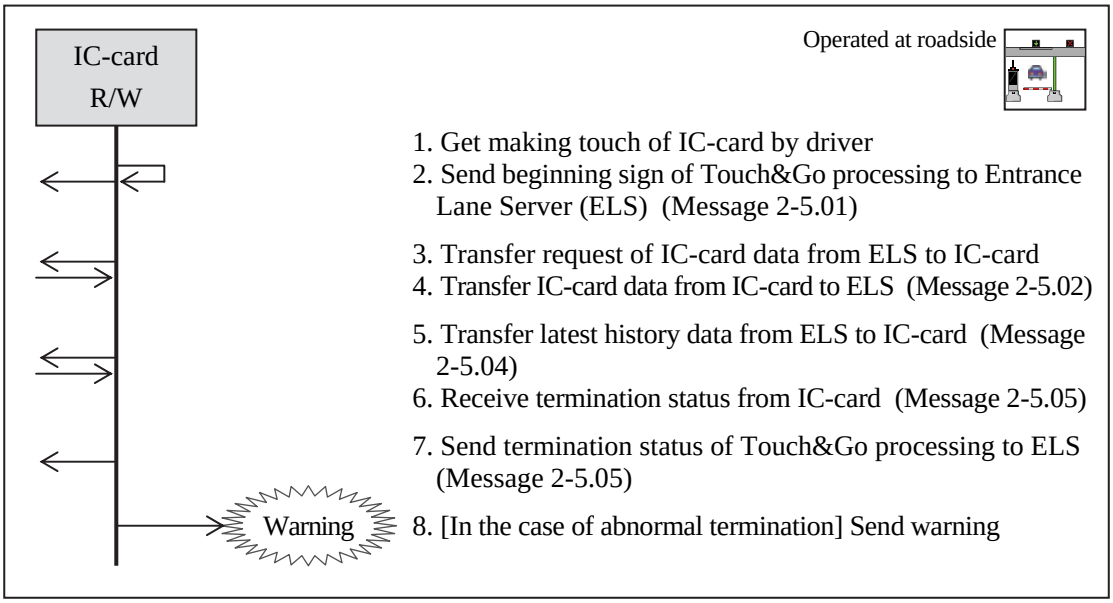


5) IC-card R/W (Roadside)

2-5-a IC-card R/W Check for Entrance

Displaying for reading/writing IC-cards at the entry tollgate and for indicating any errors.

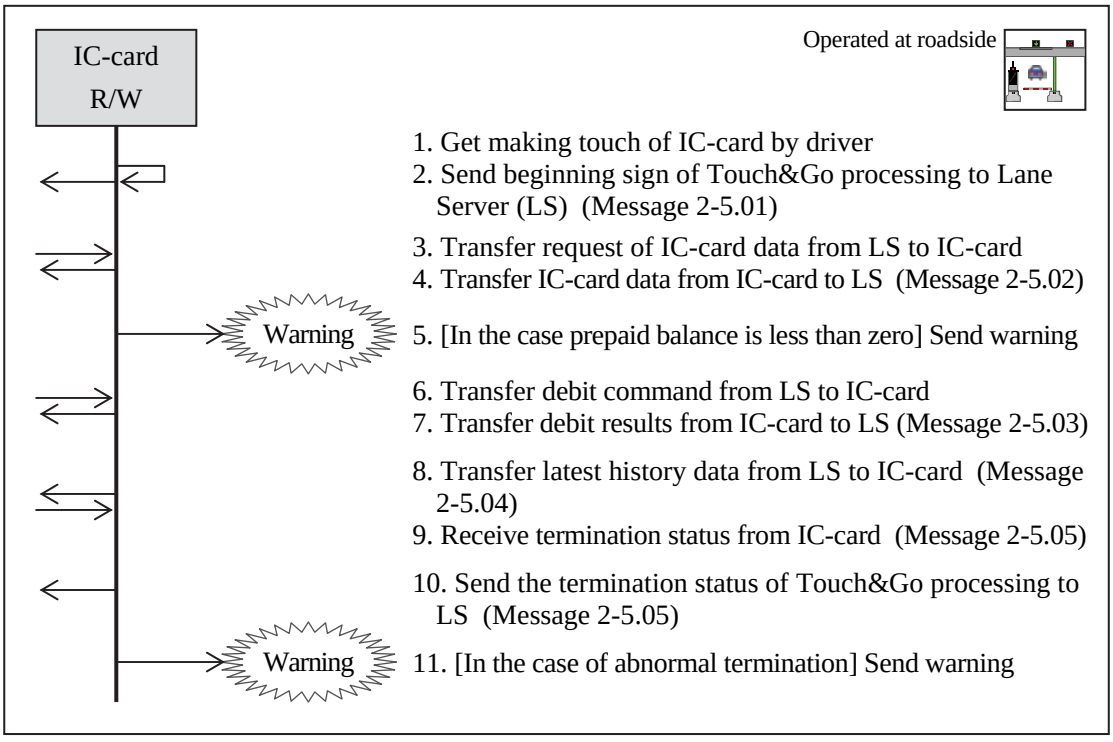
Figure 7.68 IC-card R/W Check for Entrance



2-5-b IC-card R/W Check for Exit/Flat-tariff

Displaying for reading/writing IC-cards at the exit or flat-tariff tollgate and for indicating any errors.

Figure 7.69 IC-card R/W Check for Exit/Flat-tariff

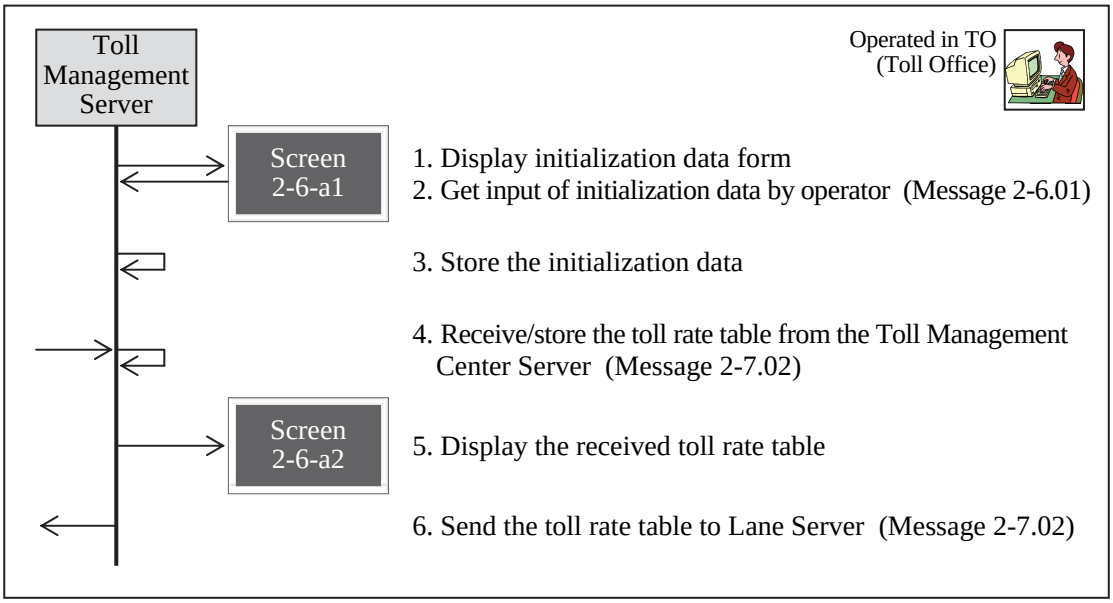


6) Toll Management Server (TO)

2-6-a Initialization for Toll Management

Displaying and processing in series for inputting the initial data required for toll management at TO, such as parameters of the tollgate lanes and lists of roadside equipment arrangement, and for receiving and saving the toll rate table updated at TMC and distributing it to each toll booth.

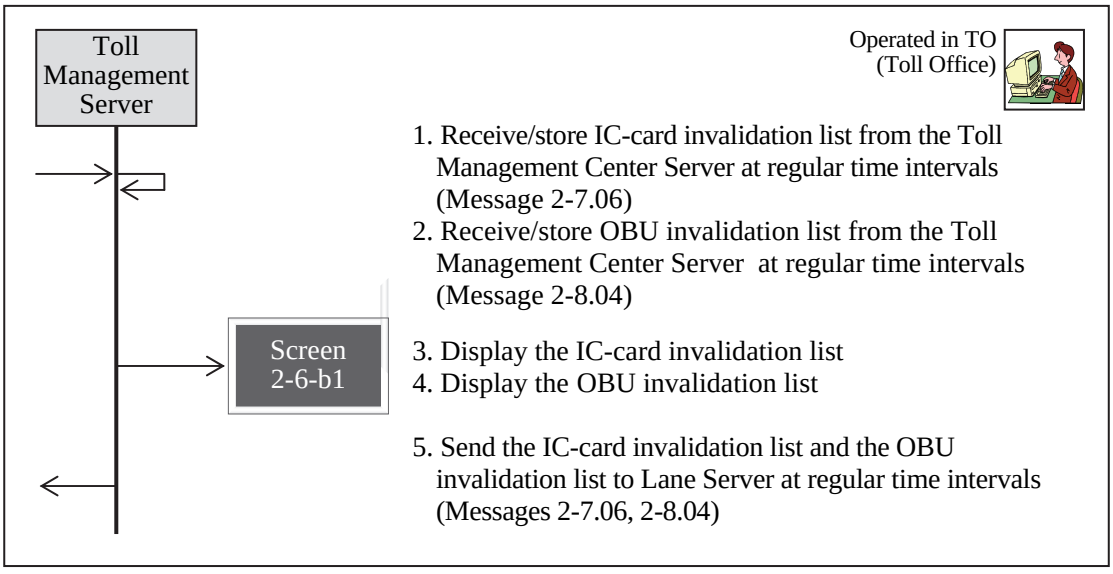
Figure 7.70 Initialization for Toll Management



2-6-b Daily Routine Processing

Displaying and processing in series for updating the lists of IC-card invalidation and OBU invalidation and for collecting and saving the results of data exchange for toll collection at each toll booth.

Figure 7.71 Daily Routine Processing

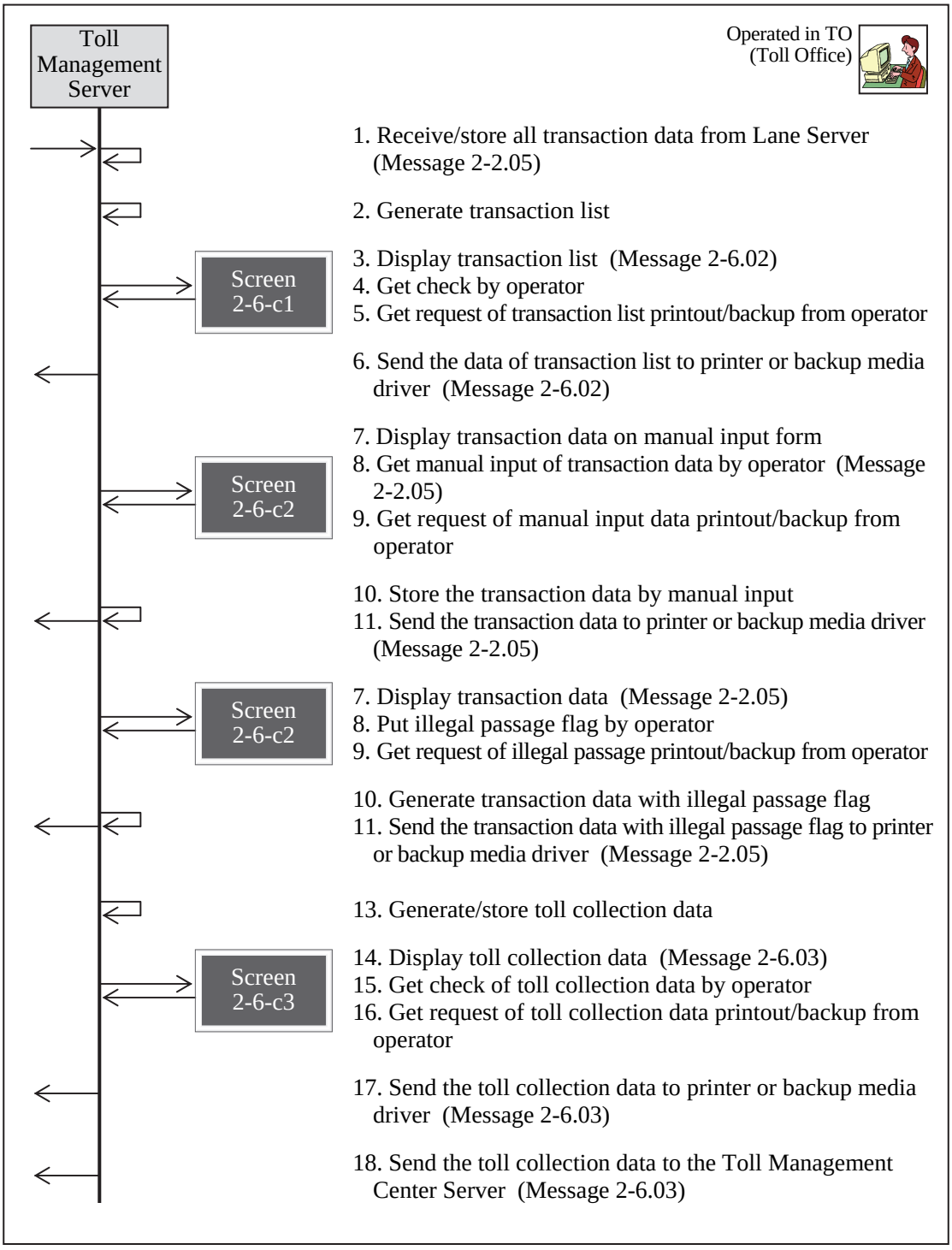


Note: "Invalidation" is intended only for the suspension of validity of an IC-card/OBU requested by the user.

2-6-c Daily/Monthly Check

Displaying and processing in series for creating the lists of results of toll collection at each toll booth and sending it to TMC, and for creating documents on unlawful passage vehicles to be submitted to the police.

Figure 7.72 Daily/Monthly Check

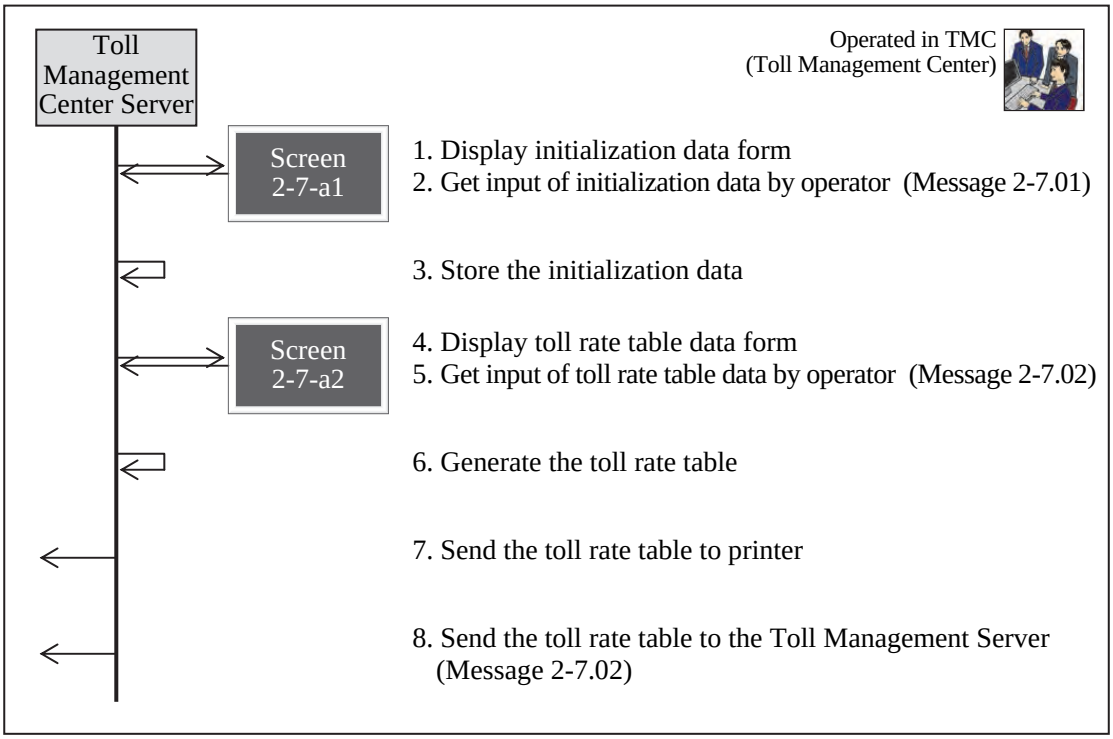


7) Toll Management Center Server (TMC)

2-7-a Initialization for Toll Management Center

Displaying and processing in series for inputting the initial data required for toll management at TMC, such as vehicle category and lists of TOs under its control, and for updating the toll rate table and distributing it to each TO.

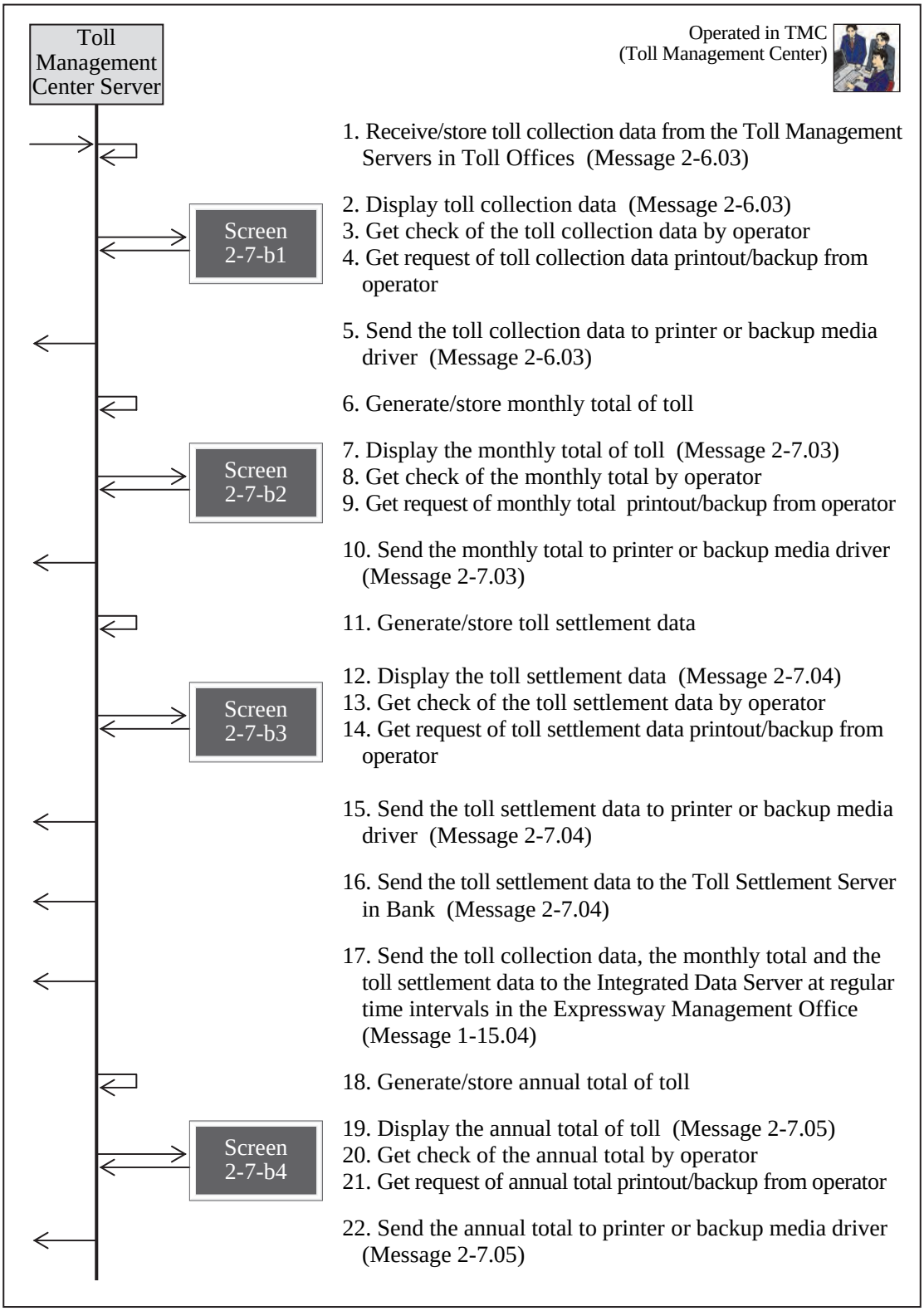
Figure 7.73 Initialization for Toll Management Center



2-7-b Monthly/Annual Total of Toll

Displaying and processing in series for summarizing the monthly/annual toll revenues of all TOs and for sending it to the Data Integration Center.

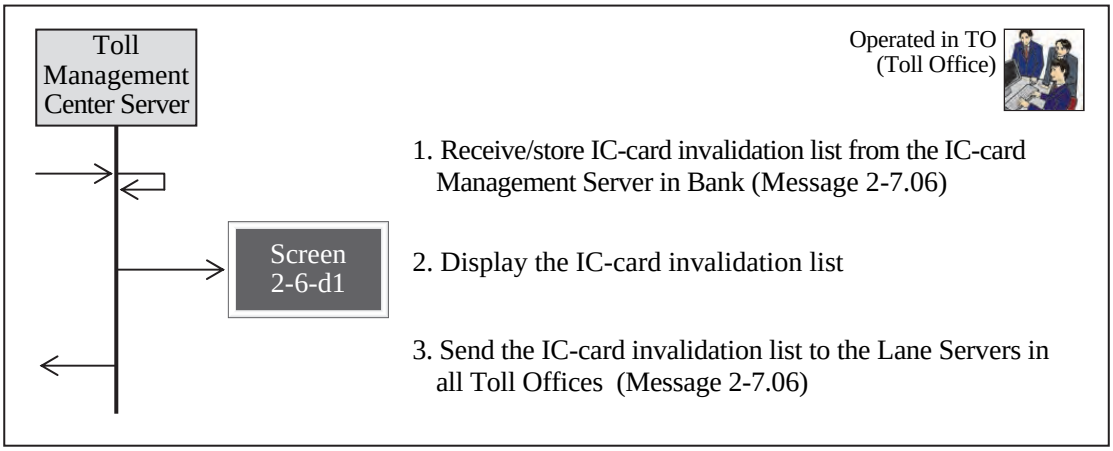
Figure 7.74 Monthly/Annual Total of Toll



2-6-d IC-card Issue/Invalidation Listing

Displaying and processing in series for updating, at an interval every day, the list of IC-card invalidation received from the bank, and for distributing them to each roadside.

Figure 7.75 IC-card Issue/Invalidation Listing

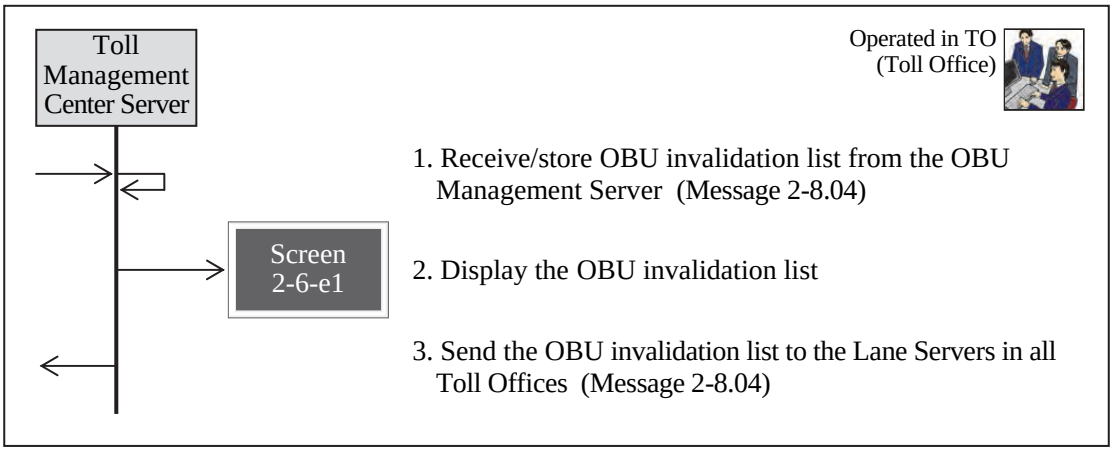


Note: "Invalidation" is intended only for the suspension of validity of an IC-card requested by the user.

2-6-e OBU Registration/Invalidation Listing

Displaying and processing in series for merging and updating, at an interval every day, the list of OBU invalidation received from the OBU Management Center, and for distributing them to each roadside.

Figure 7.76 OBU Registration/Invalidation Listing



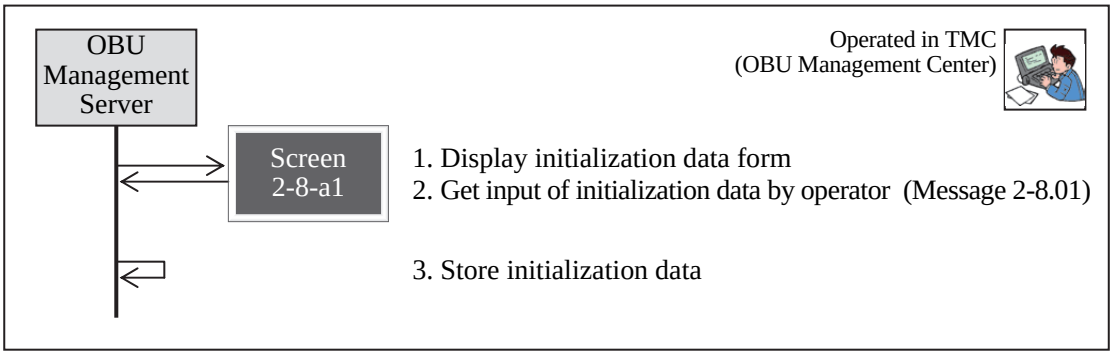
Note: "Invalidation" is intended only for the suspension of validity of an OBU requested by the user.

8) OBU Management Server (OMC)

2-8-a Initialization for OBU Management

Displaying and processing in series for inputting the initial data required for managing OBUs, such as lists of the OBU Registration Terminals.

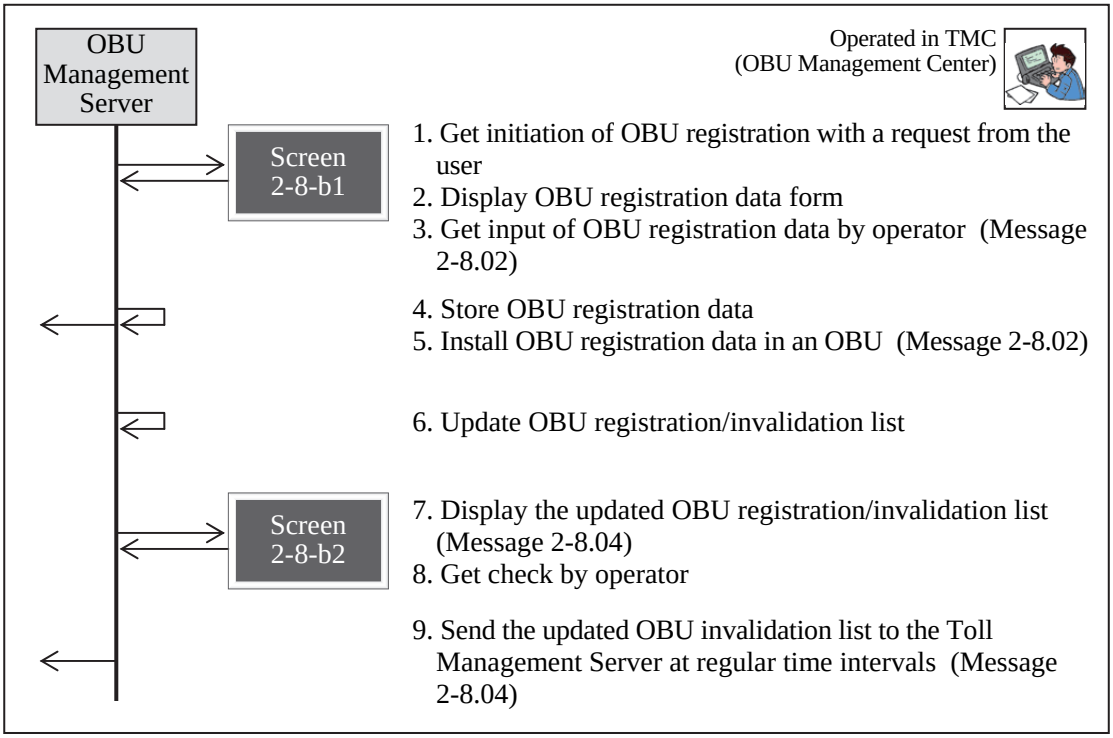
Figure 7.77 Initialization for OBU Management



2-8-b OBU Registration

Displaying and processing in series for registering or invalidating OBUs and for updating the lists of OBU registration.

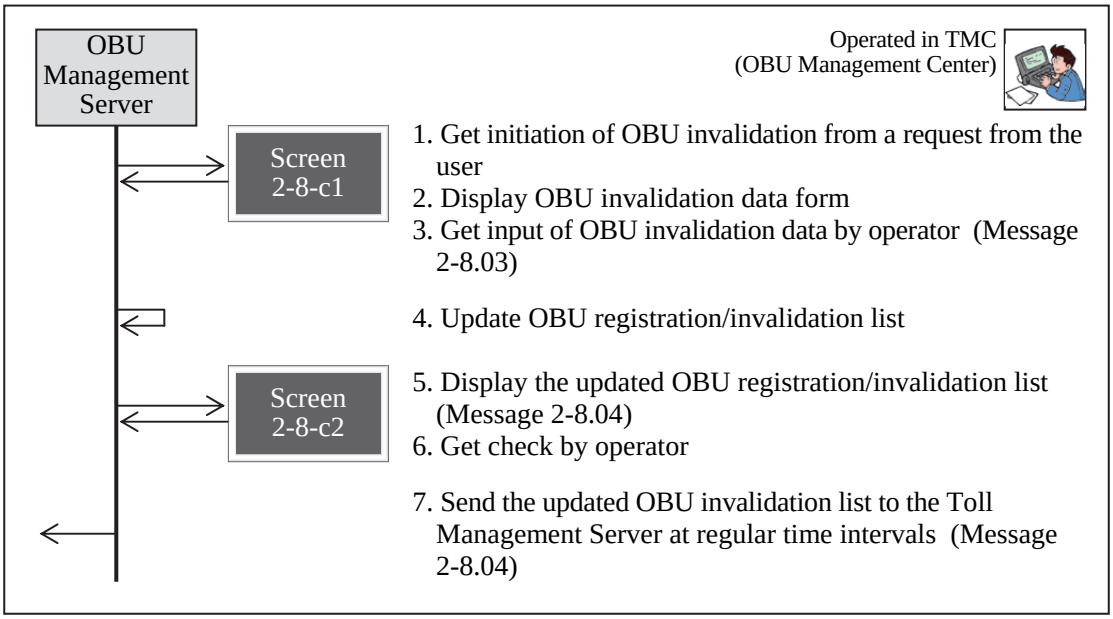
Figure 7.78 OBU Registration



2-8-c OBU Invalidation

Displaying and processing in series for invalidating OBUs and for updating the lists of OBU invalidation.

Figure 7.79 OBU Invalidation



Note: "Invalidation" is intended only for the suspension of validity of an OBU requested by the user.

7.5.2 Major Message List

The major message for automated toll collection/management system is shown in the list below.

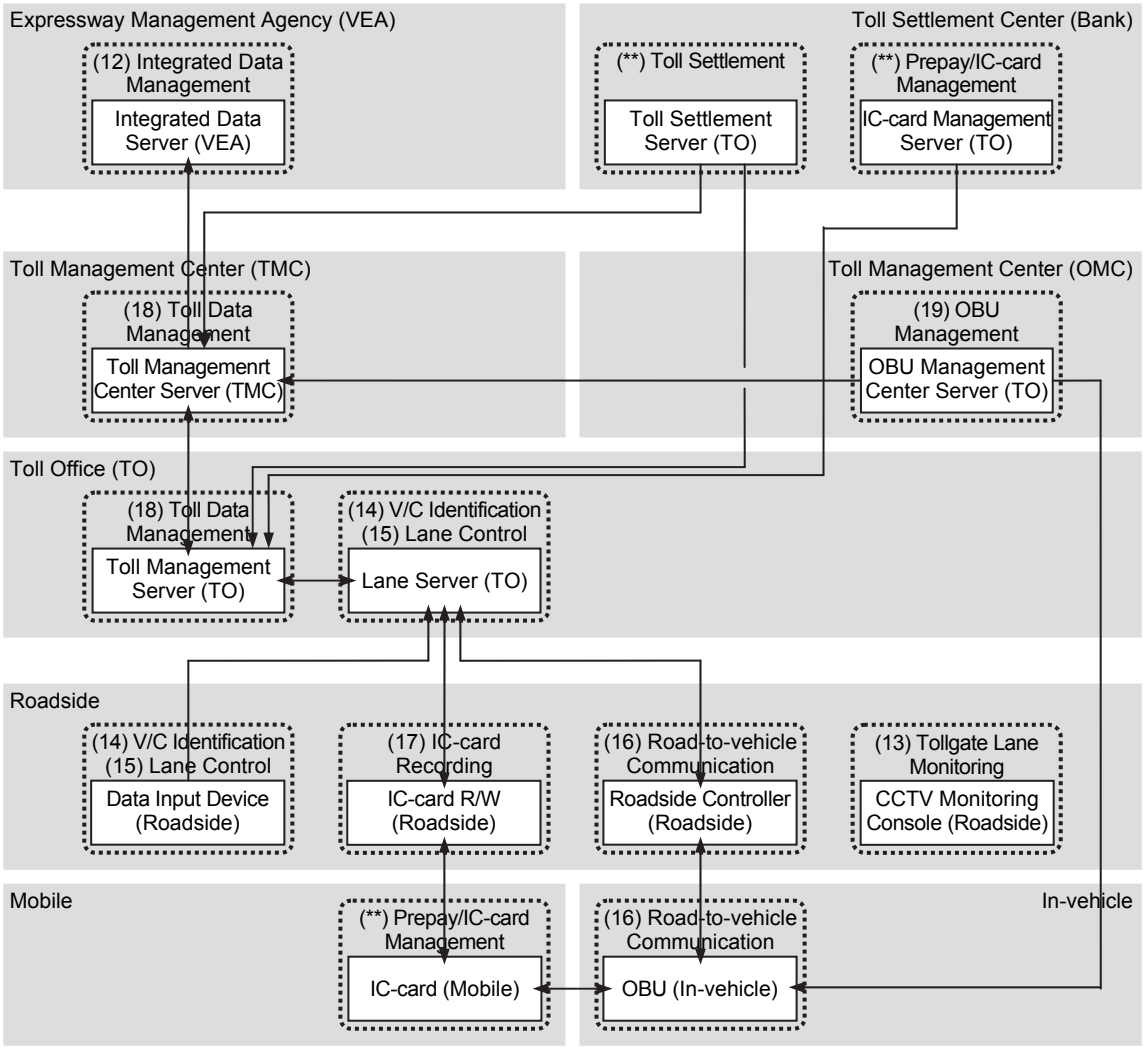
Table 7.6 Major Message List of Toll Collection/Management System

Message	Transmitter (Equipment Component)	Receiver (Equipment Component)	Major Data Sets to be Included
Message 2-1.01	CCTV Monitoring Console (TO)	Monitor Screen	Toll Rate Information Data Set
Message 2-1.02	Data Input Device	CCTV Monitoring Console (TO)	Bar-code Data Set
Message 2-2.01	Entrance Lane Server (TO)	Monitor Screen	IC-card Issue Data Set
	Lane Server (TO)	Monitor Screen	IC-card Recharge Data Set
Message 2-2.02	Data Input Device	Entrance Lane Server (TO)	IC-card Passage Data Set
	Data Input Device	Lane Server (TO)	IC-card Invalidation Data Set
Message 2-2.03	Entrance Lane Server (TO)	Entry-card	OBU Registration Data Set
	Entry-card	Lane Server (TO)	OBU Passage Data Set
Message 2-2.04	Entrance Lane Server (TO)	--	OBU Invalidation Data Set
	Lane Server (TO)	--	License Plate Data Set
Message 2-2.05	Entrance Lane Server (TO)	Toll Management Server (TO)	Transaction Data Set
	Lane Server (TO)	Toll Management Server (TO)	Toll Collection Data Set
	Toll Management Server (TO)	Monitor Screen	Hourly Toll Collection Data Set
	Toll Management Server (TO)	Printer, Backup Media Driver	Toll Revenue Data Set
Message 2-3.01	Roadside Controller (Roadside)	Entrance Lane Server (TO)	
	Roadside Controller (Roadside)	Lane Server (TO)	
Message 2-3.02	Roadside Controller (Roadside)	Entrance Lane Server (TO)	
	Roadside Controller (Roadside)	Lane Server (TO)	
Message 2-4.01	OBU (In-vehicle)	Roadside Controller (Roadside)	
	Roadside Controller (Roadside)	Entrance Lane Server (TO)	
	Roadside Controller (Roadside)	Lane Server (TO)	
Message 2-4.02	OBU (In-vehicle)	Roadside Controller (Roadside)	
	Roadside Controller (Roadside)	Entrance Lane Server (TO)	
	Roadside Controller (Roadside)	Lane Server (TO)	
Message 2-5.01	IC-card R/W (Roadside)	Entrance Lane Server (TO)	
	IC-card R/W (Roadside)	Lane Server (TO)	
Message 2-5.02	IC-card (Mobile)	OBU (In-vehicle)	
	IC-card (Mobile)	IC-card R/W (Roadside)	
	IC-card R/W (Roadside)	Entrance Lane Server (TO)	
	IC-card R/W (Roadside)	Lane Server (TO)	
Message 2-5.03	IC-card (Mobile)	OBU (In-vehicle)	
	OBU (In-vehicle)	Roadside Controller (Roadside)	
	Roadside Controller (Roadside)	Lane Server (TO)	
	IC-card (Mobile)	IC-card R/W (Roadside)	
	IC-card R/W (Roadside)	Lane Server (TO)	
Message 2-5.04	Entrance Lane Server (TO)	Roadside Controller (Roadside)	
	Lane Server (TO)	Roadside Controller (Roadside)	
	Roadside Controller (Roadside)	OBU (In-vehicle)	
	OBU (In-vehicle)	IC-card (Mobile)	
	Entrance Lane Server (TO)	IC-card R/W (Roadside)	
	Lane Server (TO)	IC-card R/W (Roadside)	
	IC-card R/W (Roadside)	IC-card (Mobile)	
Message 2-5.05	IC-card (Mobile)	OBU (In-vehicle)	
	IC-card (Mobile)	IC-card R/W (Roadside)	
	IC-card R/W (Roadside)	Entrance Lane Server (TO)	
	IC-card R/W (Roadside)	Lane Server (TO)	
Message 2-6.01	Data Input Device	Toll Management Server (TO)	
Message 2-6.02	Toll Management Server (TO)	Monitor Screen	
	Toll Management Server (TO)	Printer, Backup Media Driver	
Message 2-6.03	Toll Management Server (TO)	Monitor Screen	
	Toll Management Server (TO)	Printer, Backup Media Driver	
	Toll Management Server (TO)	Toll Management Center Server (TMC)	
	Toll Management Center Server (TMC)	Monitor Screen	
	Toll Management Center Server (TMC)	Printer, Backup Media Driver	
Message 2-7.01	Data Input Device	Toll Management Center Server (TMC)	
Message 2-7.02	Data Input Device	Toll Management Center Server (TMC)	
	Toll Management Center Server (TMC)	Toll Management Server (TO)	
	Toll Management Server (TO)	Entrance Lane Server (TO)	
	Toll Management Server (TO)	Lane Server (TO)	
Message 2-7.03	Toll Management Center Server (TMC)	Monitor Screen	

	Toll Management Center Server (TMC)	Printer, Backup Media Driver
Message 2-7.04	Toll Management Center Server (TMC)	Monitor Screen
	Toll Management Center Server (TMC)	Printer, Backup Media Driver
	Toll Management Center Server (TMC)	Toll Settlement Server (Bank)
Message 2-7.05	Toll Management Center Server (TMC)	Monitor Screen
	Toll Management Center Server (TMC)	Printer, Backup Media Driver
Message 2-7.06	Security Server (Bank)	Toll Management Server (TO)
	Toll Management Server (TO)	Entrance Lane Server (TO)
	Toll Management Server (TO)	Lane Server (TO)
Message 2-8.01	Data Input Device	OBU Management Server (OMC)
Message 2-8.02	Data Input Device	OBU Management Server (OMC)
	OBU Management Server (OMC)	OBU (In-vehicle)
Message 2-8.03	Data Input Device	OBU Management Server (OMC)
Message 2-8.04	OBU Management Server (OMC)	Monitor Screen
	OBU Management Server (OMC)	Toll Management -Server (TO)
	Toll Management Server (TO)	Entrance Lane Server (TO)
	Toll Management Server (TO)	Lane Server (TO)
Message 1-15.04	Toll Management Center Server (TMC)	Integrated Data Server (VEA)

Source: ITS Integration Project (SAPI) Study Team

Figure 7.80 Message Exchange among Major Equipment Components



Note: VEA: Expressway Management Agency, TMC: Toll Management Center, TO: Toll Office, OMC: OBU Management Center, ** : Functional Packages out of scope for the road operators.

7.5.3 Primary Data Dictionary

The primary data dictionary for the major data sets of automated toll collection/management system is shown in the table below.

Table 7.7 Primary Data Dictionary for Toll Collection/Management

	Major Data Set <Origin>	Data Elements	Type	Digit	Set	Update Cycle	Storage Period for Origin	Definition
16	Toll Rate Information Data Set <R - Server>	Number of tollgate pair	INT	8	1	Daily	1 year	The number of tollgate pair (N)
		Tollgate Pair ID	INT	8	N			An unique identifier of a pair of tollgate
		Entrance Tollgate ID	INT*	4				An unique identifier of the entrance tollgate
		Exit Tollgate ID	INT*	4				An unique identifier of the exit tollgate
		Toll Rate of Vehicle Class 1	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 1: Cars with seats of 12 or less, trucks with a capacity less than 2 tons, mass transit buses
		Toll Rate of Vehicle Class 2	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 2: Cars seats between 12 and 30, trucks with a capacity between 2 and 4 tons
		Toll Rate of Vehicle Class 3	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 3: Cars with seats of 31 or more, trucks with a capacity between 4 and 10 tons
		Toll Rate of Vehicle Class 4	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 4: Trucks with a capacity between 10 and 18 tons, 20ft-container lorries
		Toll Rate of Vehicle Class 5	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 5: Trucks with a capacity of 18 tons or more, 40ft-container lorries
		Toll Rate of Vehicle Class 6	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 6: Military vehicles in the missions
		Toll Rate of Vehicle Class 7	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 7: Public security vehicles in the missions
		Toll Rate of Vehicle Class 8	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 8: Reserved
		Toll Rate of Vehicle Class 9	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 9: Reserved
		Toll Rate of Vehicle Class 10	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 10: Reserved
		Toll Rate of Vehicle Class 11	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 11: Reserved
		Toll Rate of Vehicle Class 12	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 12: Reserved
		Toll Rate of Vehicle Class 13	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 13: Reserved
		Toll Rate of Vehicle Class 14	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 14: Reserved
		Toll Rate of Vehicle Class 15	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 15: Reserved
		Toll Rate of Vehicle Class 16	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 16: Reserved
		Toll Rate of Vehicle Class 17	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 17: Reserved
		Toll Rate of Vehicle Class 18	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 18: Reserved
		Toll Rate of Vehicle Class 19	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 19: Reserved
		Toll Rate of Vehicle Class 20	FLOAT	12				Toll rate from Ent to Exit for Vehicle Class 20: Reserved
		Number of document	TXT	20				Official number of permission document
		Date of Toll Rate Table	TXT	8				Day/month/year of the toll rate information for the pair of tollgate
17	Bar-code Data Set <G - Lane Server>	Toll Office ID	INT*	4	1	Each passage at tollgate	1 month	An unique identifier of a toll office
		Tollgate ID	INT*	4	1			An unique identifier of a tollgate
		Lane ID	INT*	2	1			An unique identifier of the lane where a construction work applied (Numbered from the median)
		Deposit Terminal ID	INT*	4	1			An unique identifier of the deposit terminal
		Ticket Type	INT*	4	1			Type of ticket
		Vehicle Class	INT*	2	1			Vehicle class: - 1: Cars with seats of 12 or less, trucks with a capacity less than 2 tons, mass transit buses - 2: Cars seats between 12 and 30, trucks with a capacity between 2 and 4 tons - 3: Cars with seats of 31 or more, trucks with a capacity between 4 and 10 tons - 4: Trucks with a capacity between 10 and 18 tons, 20ft-container lorries - 5: Trucks with a capacity of 18 tons or more, 40ft-container lorries - 6: Military vehicles in the missions - 7: Public security vehicles in the missions
		Serial Number	INT	12	1			Serial number of the ticket
		Date Issue	Date	8	1			Day/month/year of issuing ticket
		Date of Expiry	Date	8	1			Day/month/year of ticket expiration
18	IC-card Issue Data Set <R - IC-card>	Status	INT*	1	1	IC-card issue	Permanent	Card status: 0: initial, 1: normal, 2: on-road, 3: voided
		Issuer ID	INT*	4	1			An unique identifier of an issuer organization
		Issue Terminal ID	INT	12	1			An unique identifier of an issue terminal equipment
		IC-card ID	INT	12	1			An unique identifier of an IC-card
		IC-card Owner ID	INT	18	1			An unique identifier of IC-card owner
		Amount of Deposit	FLOAT	8	1			The amount of electric money deposited to the account (unit: thousand VND)
		Date/Time of Issue	TXT	≥14	1			Day/month/year/hour/minutes/second of issuing IC-card
		Date/Time of Expiry	TXT	≥14	1			Day/month/year/hour/minutes/second of expiring IC-card
19	IC-card Recharge Data Set <R - IC-card>	Status	INT*	1	N	Each recharge	Permanent	Card status: 0: initial, 1: normal, 2: on-road, 3: voided
		Issuer ID	INT*	4				An unique identifier of an issuer organization
		Deposit Terminal ID	INT	12				An unique identifier of a terminal device
		IC-card ID	INT	12				An unique identifier of an IC-card
		IC-card Owner ID	INT	18				An unique identifier of IC-card owner
		Amount of Deposit	FLOAT	8				The amount of electric money deposited to the prepared account (unit: thousand VND)
		Prepaid Balance	FLOAT	8				The remaining amount of electric money in an IC-card (unit: thousand VND)
		Date/Time	Datetime	≥14				Year/ month/day/hour/minutes/second of generating data set

20	IC-card Passage Data Set <R - IC-card>	Status	INT*	1	N	Each passage at tollgate	Latest	Card status: 0: initial, 1: normal, 2: on-road, 3: voided
		Toll Office ID	INT*	4				An unique identifier of a toll office
		Tollgate ID	INT	8				An unique identifier of a toll gate
		Lane ID	INT	12				An unique identifier of a lane (Numbered from the median)
		Toll Amount	FLOAT	8				A toll charge collected by the system when a vehicle passing through a tollgate using ETC, Touch&Go toll collection or Manual toll collection. (unit: thousand VND)
		Prepaid Balance	FLOAT	8				The remaining amount of electric money in an IC-card (unit: thousand VND)
		Date/Time	Datetime	≥14				Year/ month/day/hour/minutes/second of generating data set
21	IC-card Invalidation List Data Set <G - Server>	Issuer ID	INT*	4	1	Daily + Upon Demand	1 year	An unique identifier of an issuer organization
		Issue Terminal ID	INT	12	N			An unique identifier of an issue terminal equipment
		IC-card ID for Invalidation	INT	12				An unique identifier of an IC-card of invalidation
		IC-card Owner ID	INT	18				An unique identifier of IC-card owner
		Prepaid Balance	FLOAT	8				The remaining amount of electric money in an IC Card (unit: thousand VND)
		Date/Time of Issue	TXT	≥14				Day/month/year/hour/minutes/second of issuing IC-card
		Date/Time of Expiry	TXT	≥14				Day/month/year/hour/minutes/second of expiring IC-card
		Date/Time	Datetime	≥14	1			Year/ month/day/hour/minutes/second of generating data set
22	OBU Registration Data Set <R - OBU>	Management Organization ID	INT	12	1	OBU registration	Permanent	An unique identifier of OBU management organization
		OBU ID	INT	12	1			An unique identifier of an OBU
		OBU Owner ID	INT	18	1			An unique identifier of OBU owner
		License Plate Number	TXT	12	1			License plate number recorded in OBU
		Vehicle Class	TXT	2	1			Vehicle class recorded in OBU: - 1: Cars with seats of 12 or less, trucks with a capacity less than 2 tons, mass transit buses - 2: Cars seats between 12 and 31, trucks with a capacity between 2 and 4 tons - 3: Cars with seats of 31 or more, trucks with a capacity between 4 and 10 tons - 4: Trucks with a capacity between 10 and 18 tons, 20ft-container lorries - 5: Trucks with a capacity of 18 tons or more, 40ft-container lorries - 6: Military vehicles in the missions - 7: Public security vehicles in the missions
		Date of Issue	TXT	8	1			Day/month/year of issuing OBU
		Date of Expiry	TXT	8	1			Day/month/year of OBU expiration
23	OBU Passage Data Set <R - OBU>	Toll Office ID	INT*	4	3	Each passage at tollgate	Latest	An unique identifier of a toll office
		Tollgate ID	INT*	4				An unique identifier of a tollgate
		Lane ID	INT*	4				An unique identifier of a lane (Numbered from the median)
		IC-card ID	INT	12				An unique identifier of an IC-card
		Toll Amount	FLOAT	4				A toll charge collected by the system when a vehicle passing through a tollgate using ETC, Touch&Go toll collection or Manual toll collection. (unit: thousand VND)
		Prepaid Balance	INT	8				Prepaid balance copied from an IC-card
		Date/Time	Datetime	≥14				Year/ month/day/hour/minutes/second of generating data set
24	OBU Invalidation List Data Set <G - Server>	Management Organization ID	INT	12	1	Daily + Upon Demand	1 year	An unique identifier of OBU management organization
		OBU ID for Invalidation	INT	12	N			An unique identifier of an OBU of invalidation
		OBU Owner ID	INT	18				An unique identifier of OBU owner
		License Plate Number	TXT	12				License plate number recorded in OBU
		Vehicle Class	TXT	2				Vehicle class recorded in OBU - 1: Cars with seats of 12 or less, trucks with a capacity less than 2 tons, mass transit buses - 2: Cars seats between 12 and 31, trucks with a capacity between 2 and 4 tons - 3: Cars with seats of 31 or more, trucks with a capacity between 4 and 10 tons - 4: Trucks with a capacity between 10 and 18 tons, 20ft-container lorries - 5: Trucks with a capacity of 18 tons or more, 40ft-container lorries - 6: Military vehicles in the missions - 7: Public security vehicles in the missions
		Date of Issue	TXT	8				Day/month/year of issuing OBU
		Date of Expiry	TXT	8				Day/month/year of OBU expiration
		Date/Time	Datetime	≥14	1			Year/ month/day/hour/minutes/second of generating data set
25	Toll Collection License Plate Data Set <G - Image Processor>	Toll Office ID	INT*	4	1	Each passage at tollgate	6 months	An unique identifier of a toll office
		Tollgate ID	INT*	4	1			An unique identifier of a tollgate
		Lane ID	INT*	4	1			An unique identifier of a lane (Numbered from the median)
		Roadside Equipment ID	INT*	4	1			An unique identifier of a license recognition device
		Captured License Plate Number	TXT	12	1			License plate number recognized by image processor
		Captured License Plate Image	IMG	var	1			The license plate image captured by CCTV camera
		Serial Number of Vehicle	INT*	5	1			Daily serial number for a vehicle passing through tollgate. (For reference to other data set)
		Date/Time	Datetime	≥14	1			Year/ month/day/hour/minutes/second of generating data set
26	Transaction Data Set <R - Lane Server>	Toll Office ID	INT*	4	1	Each passage at tollgate	6 months	An unique identifier of a toll office
		Tollgate ID	INT	8	1			An unique identifier of a toll gate
		Lane ID	INT*	4	1			An unique identifier of a lane (Numbered from the median)
		OBU ID	INT	12	1			An unique identifier of OBU
		Vehicle Class in OBU	INT*	2	1			Vehicle class recorded in OBU - 1: Cars with seats of 12 or less, trucks with a capacity less than 2 tons, mass transit buses - 2: Cars seats between 12 and 30, trucks with a capacity between 2 and 4 tons - 3: Cars with seats of 31 or more, trucks with a capacity between 4 and 10 tons - 4: Trucks with a capacity between 10 and 18 tons, 20ft-container lorries - 5: Trucks with a capacity of 18 tons or more, 40ft-container lorries - 6: Military vehicles in the missions - 7: Public security vehicles in the missions

		License number in OBU	TXT	12	1			License number recorded in OBU
		IC-card ID	INT	12	1			An unique identifier of an IC-card
		Toll Amount	INT	8	1			A toll charge collected by the system when a vehicle passing through a tollgate using ETC, Touch&Go toll collection or Manual toll collection. (unit: thousand VND)
		Prepaid Balance	FLOAT	8	1			The remaining amount of electric money in an IC-card (unit: thousand VND)
		Termination Status	INT*	2	1			Data for indicating a toll collection procedure has finished successfully or not
		Serial Number of Vehicle	INT	5	1			Daily serial number for a vehicle passing through tollgate. (For reference to other data set)
		Date/Time	Datetime	≥14	1			Year/ month/day/hour/minutes/second of generating data set
27	Toll Collection Data Set <G - Lane Server>	Road Owner ID	INT*	4	1	Every 10 minutes	6 months	An unique identifier of a road owner
		Toll Office ID	INT*	4	1			An unique identifier of a toll office
		Date of Toll Amount	TXT	8	1			Day/month/year of the toll amount
		Sum of Toll Amount	INT*	12	1			A sum of colleted toll amount of vehicles passing through the tollgate
		Number of Vehicle Passage	INT	8	1			Number of vehicles passing through the tollgate
		Transaction Data Set	Set	var	N			Transaction data set of a vehicle passing through the tollgate
		Enforcement Status	TXT	2				Status for indicating the enforcement status: - 0: Successful. - 1: Vehicle passage that has different scanned license plate number compared to OBU. Suspicion of spoofing. - 2: Vehicle passage with continuously negative balance in IC-card. Suspicion of cheating. - 3: Vehicle passage without OBU and/or IC-card.
		Date/Time	Datetime	≥14	1			Year/ month/day/hour/minutes/second of generating data set
28	Hourly Toll Collection Data Set <G/C - Server>	Road Owner ID	INT*	4	1	Hourly	1 year	An unique identifier of a road owner
		Toll Office ID	INT*	4	1			An unique identifier of a toll office
		Date/Hour of Record	TXT	10	1			Day/month/year/hour of the record
		Sum of Toll Amount	FLOAT	12	1			Total toll amount of vehicles passing through the tollgate (unit: thousand VND)
		Number of Vehicle Passage	INT	8	1			Number of vehicles passing through the tollgate
		Sum of Toll of Vehicle Class 1	FLOAT	12	1			Total toll amount of class 1: Cars with seats of 12 or less, trucks with a capacity less than 2 tons, mass transit buses (unit: thousand VND)
		Number of Vehicle of Class 1	INT	8	1			Number of vehicles of class 1
		Sum of Toll of Vehicle Class 2	FLOAT	12	1			Total toll amount of class 2: Cars seats between 12 and 30, trucks with a capacity between 2 and 4 tons (unit: thousand VND)
		Number of Vehicle of Class 2	INT	8	1			Number of vehicles of class 2
		Sum of Toll of Vehicle Class 3	FLOAT	12	1			Total toll amount of class 3: Cars with seats of 31 or more, trucks with a capacity between 4 and 10 tons (unit: thousand VND)
		Number of Vehicle of Class 3	INT	8	1			Number of vehicles of class 3
		Sum of Toll of Vehicle Class 4	FLOAT	12	1			Total toll amount of class 4: Trucks with a capacity between 10 and 18 tons, 20ft-container lorries (unit: thousand VND)
		Number of Vehicle of Class 4	INT	8	1			Number of vehicles of class 4
		Sum of Toll of Vehicle Class 5	FLOAT	12	1			Total toll amount of class 5: Trucks with a capacity of 18 tons or more, 40ft-container lorries (unit: thousand VND)
		Number of Vehicle of Class 5	INT	8	1			Number of vehicles of class 5
		Sum of Toll of Vehicle Class 6	FLOAT	12	1			Total toll amount of class 6: Military vehicles in the missions (unit: thousand VND)
		Number of Vehicle of Class 6	INT	8	1			Number of vehicles of class 6
		Sum of Toll of Vehicle Class 7	FLOAT	12	1			Total toll amount of class 7: Public security vehicles in the missions (unit: thousand VND)
		Number of Vehicle of Class 7	INT	8	1			Number of vehicles of class 7
		Sum of Toll of Vehicle Class 8	FLOAT	12	1			Total toll amount of class 8: Reserved(unit: thousand VND)
		Number of Vehicle of Class 8	INT	8	1			Number of vehicles of class 8
		Sum of Toll of Vehicle Class 9	FLOAT	12	1			Total toll amount of class 9: Reserved(unit: thousand VND)
		Number of Vehicle of Class 9	INT	8	1			Number of vehicles of class 9
		Sum of Toll of Vehicle Class 10	FLOAT	12	1			Total toll amount of class 10: Reserved(unit: thousand VND)
		Number of Vehicle of Class 10	INT	8	1			Number of vehicles of class 10
		Sum of Toll of Vehicle Class 11	FLOAT	12	1			Total toll amount of class 11: Reserved(unit: thousand VND)
		Number of Vehicle of Class 11	INT	8	1			Number of vehicles of class 11
		Sum of Toll of Vehicle Class 12	FLOAT	12	1			Total toll amount of class 12: Reserved(unit: thousand VND)
		Number of Vehicle of Class 12	INT	8	1			Number of vehicles of class 12
		Sum of Toll of Vehicle Class 13	FLOAT	12	1			Total toll amount of class 13: Reserved(unit: thousand VND)
		Number of Vehicle of Class 13	INT	8	1			Number of vehicles of class 13
		Sum of Toll of Vehicle Class 14	FLOAT	12	1			Total toll amount of class 14: Reserved(unit: thousand VND)
		Number of Vehicle of Class 14	INT	8	1			Number of vehicles of class 14
		Sum of Toll of Vehicle Class 15	FLOAT	12	1			Total toll amount of class 15: Reserved(unit: thousand VND)
		Number of Vehicle of Class 15	INT	8	1			Number of vehicles of class 15
		Sum of Toll of Vehicle Class 16	FLOAT	12	1			Total toll amount of class 16: Reserved(unit: thousand VND)
		Number of Vehicle of Class 16	INT	8	1			Number of vehicles of class 16
		Sum of Toll of Vehicle Class 17	FLOAT	12	1			Total toll amount of class 17: Reserved(unit: thousand VND)
		Number of Vehicle of Class 17	INT	8	1			Number of vehicles of class 17
		Sum of Toll of Vehicle Class 18	FLOAT	12	1			Total toll amount of class 18: Reserved(unit: thousand VND)
		Number of Vehicle of Class 18	INT	8	1			Number of vehicles of class 18
		Sum of Toll of Vehicle Class 19	FLOAT	12	1			Total toll amount of class 19: Reserved(unit: thousand VND)
		Number of Vehicle of Class 19	INT	8	1			Number of vehicles of class 19
		Sum of Toll of Vehicle Class 20	FLOAT	12	1			Total toll amount of class 20: Reserved(unit: thousand VND)
		Number of Vehicle of Class 20	INT	8	1			Number of vehicles of class 20
		Date/Time	Datetime	≥14	1			Year/ month/day/hour/minutes/second of generating data set

29	Toll Revenue Data Set <G/C - Server>	Road Owner ID	INT*	4	1	Monthly	1 year	An unique identifier of a road owner
		Fiscal Month	TXT	6	1			Number of fiscal month
		Toll Revenue of The Month/Week	FLOAT	16	1			Toll revenue of the fiscal period (unit: thousand VND)
		Number of Vehicle Passage	INT	8	1			Number of vehicles passing through the tollgate
		Sum of Toll of Vehicle Class 1	FLOAT	12	1			Total toll amount of class 1: Cars with seats of 12 or less, trucks with a capacity less than 2 tons, mass transit buses (unit: thousand VND)
		Number of Vehicle of Class 1	INT	8	1			Number of vehicles of class 1
		Sum of Toll of Vehicle Class 2	FLOAT	12	1			Total toll amount of class 2: Cars seats between 12 and 30, trucks with a capacity between 2 and 4 tons (unit: thousand VND)
		Number of Vehicle of Class 2	INT	8	1			Number of vehicles of class 2
		Sum of Toll of Vehicle Class 3	FLOAT	12	1			Total toll amount of class 3: Cars with seats of 31 or more, trucks with a capacity between 4 and 10 tons (unit: thousand VND)
		Number of Vehicle of Class 3	INT	8	1			Number of vehicles of class 3
		Sum of Toll of Vehicle Class 4	FLOAT	12	1			Total toll amount of class 4: Trucks with a capacity between 10 and 18 tons, 20ft-container lorries (unit: thousand VND)
		Number of Vehicle of Class 4	INT	8	1			Number of vehicles of class 4
		Sum of Toll of Vehicle Class 5	FLOAT	12	1			Total toll amount of class 5: Trucks with a capacity of 18 tons or more, 40ft-container lorries (unit: thousand VND)
		Number of Vehicle of Class 5	INT	8	1			Number of vehicles of class 5
		Sum of Toll of Vehicle Class 6	FLOAT	12	1			Total toll amount of class 6: Military vehicles in the missions (unit: thousand VND)
		Number of Vehicle of Class 6	INT	8	1			Number of vehicles of class 6
		Sum of Toll of Vehicle Class 7	FLOAT	12	1			Total toll amount of class 7: Public security vehicles in the missions (unit: thousand VND)
		Number of Vehicle of Class 7	INT	8	1			Number of vehicles of class 7
		Sum of Toll of Vehicle Class 8	FLOAT	12	1			Total toll amount of class 8: Reserved(unit: thousand VND)
		Number of Vehicle of Class 8	INT	8	1			Number of vehicles of class 8
		Sum of Toll of Vehicle Class 9	FLOAT	12	1			Total toll amount of class 9: Reserved(unit: thousand VND)
		Number of Vehicle of Class 9	INT	8	1			Number of vehicles of class 9
		Sum of Toll of Vehicle Class 10	FLOAT	12	1			Total toll amount of class 10: Reserved(unit: thousand VND)
		Number of Vehicle of Class 10	INT	8	1			Number of vehicles of class 10
		Sum of Toll of Vehicle Class 11	FLOAT	12	1			Total toll amount of class 11: Reserved(unit: thousand VND)
		Number of Vehicle of Class 11	INT	8	1			Number of vehicles of class 11
		Sum of Toll of Vehicle Class 12	FLOAT	12	1			Total toll amount of class 12: Reserved(unit: thousand VND)
		Number of Vehicle of Class 12	INT	8	1			Number of vehicles of class 12
		Sum of Toll of Vehicle Class 13	FLOAT	12	1			Total toll amount of class 13: Reserved(unit: thousand VND)
		Number of Vehicle of Class 13	INT	8	1			Number of vehicles of class 13
		Sum of Toll of Vehicle Class 14	FLOAT	12	1			Total toll amount of class 14: Reserved(unit: thousand VND)
		Number of Vehicle of Class 14	INT	8	1			Number of vehicles of class 14
		Sum of Toll of Vehicle Class 15	FLOAT	x	1			Total toll amount of class 15: Reserved(unit: thousand VND)
		Number of Vehicle of Class 15	INT	8	1			Number of vehicles of class 15
		Sum of Toll of Vehicle Class 16	FLOAT	12	1			Total toll amount of class 16: Reserved(unit: thousand VND)
		Number of Vehicle of Class 16	INT	8	1			Number of vehicles of class 16
		Sum of Toll of Vehicle Class 17	FLOAT	12	1			Total toll amount of class 17: Reserved(unit: thousand VND)
		Number of Vehicle of Class 17	INT	8	1			Number of vehicles of class 17
		Sum of Toll of Vehicle Class 18	FLOAT	12	1			Total toll amount of class 18: Reserved(unit: thousand VND)
		Number of Vehicle of Class 18	INT	8	1			Number of vehicles of class 18
		Sum of Toll of Vehicle Class 19	FLOAT	12	1			Total toll amount of class 19: Reserved(unit: thousand VND)
		Number of Vehicle of Class 19	INT	8	1			Number of vehicles of class 19
		Sum of Toll of Vehicle Class 20	FLOAT	12	1			Total toll amount of class 20: Reserved(unit: thousand VND)
		Number of Vehicle of Class 20	INT	8	1			Number of vehicles of class 20
		Date/Time	Datetime	≥14	1			Year/ month/day/hour/minutes/second of generating data set
30	IC-card History Data Set <R - IC-card>	Status	INT*	1	N	Each event such as passage at tollgate	1 year	Card status: 0: initial, 1: normal, 2: on-road, 3: voided
		Issuer ID	INT*	4				An uniqgate-inue identifier of an issuer organization
		IC-card ID	INT	12				An unique identifier of an issue terminal equipment
		IC-card Owner ID	INT	18				An unique identifier of IC-card owner
		Toll Office ID	INT*	4				An unique identifier of a toll office
		Tollgate ID	INT	8				An unique identifier of a toll gate
		Lane ID	INT	12				An unique identifier of a lane (Numbered from the median)
		Deposit Terminal ID	INT	12				An unique identifier of a terminal device
		Event	INT*	2				0: gate-in, 1: gate-out, 2: recharging
		Date/Time	Datetime	≥14				Year/ month/day/hour/minutes/second of generating data set

Note: IMG: Image, TXT: Text, FLOAT: Floating-point complex number, INT: Integer, INT*: Short integer, I: Input, G: Generated, C: Checked, R: Recorded.

Source: The Study Team

7.6 Vehicle Weighing System (For Reference)

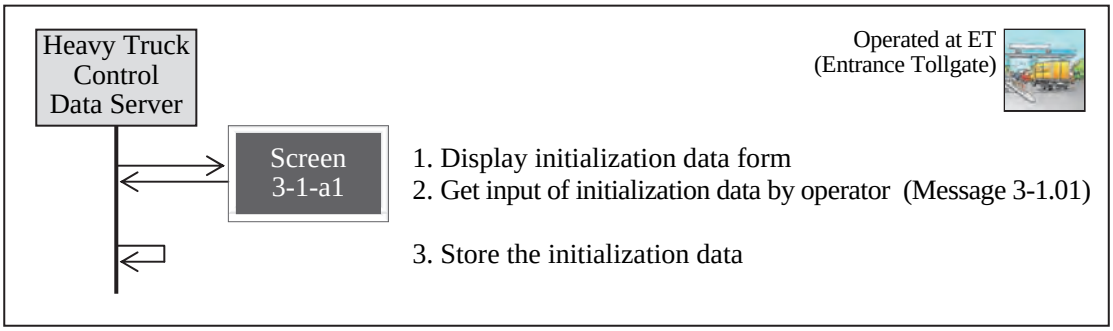
7.6.1 Processing/Screen Transition Diagrams

1) Heavy Truck Control Data Server (ET)

3-1-a Initialization for Axle Load Measurement

Displaying and processing in series for inputting the initial data required for axle load measurement and its management, such as the list of roadside equipment installed at TO and the threshold value for axle load management.

Figure 7.81 Initialization for Axle Load Measurement

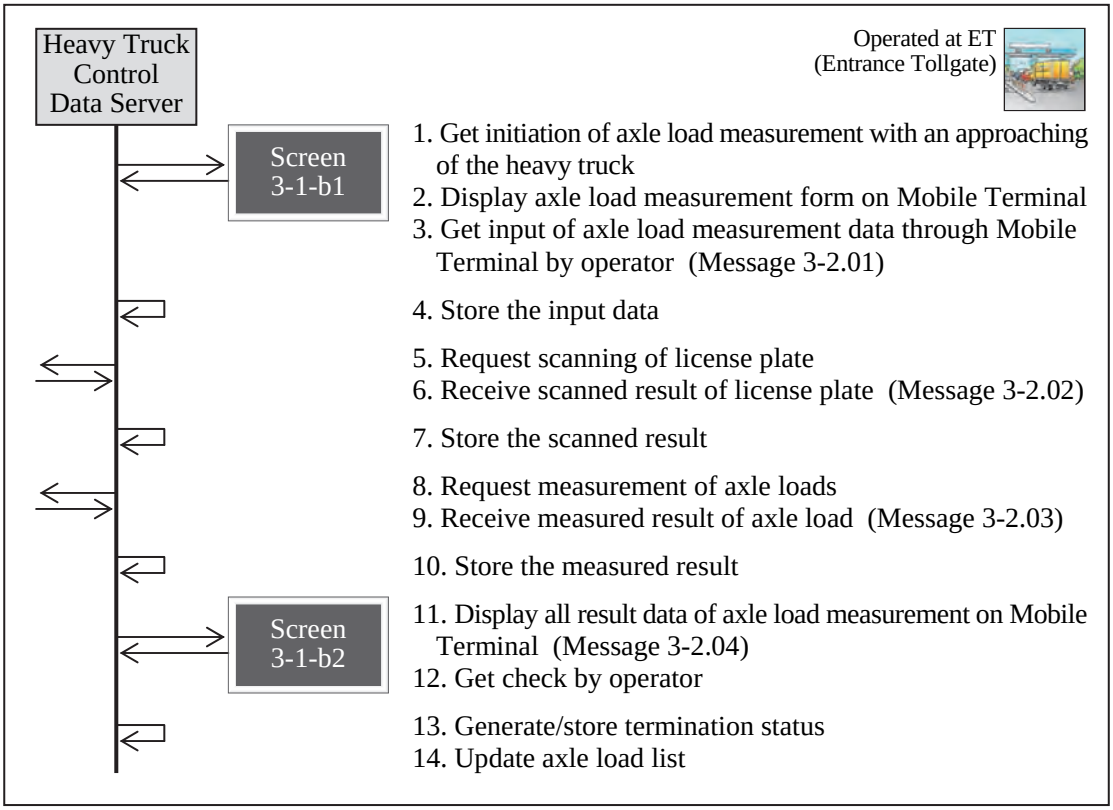


Note: The function of this operation procedure can be executed only in TO (Toll Office).

3-1-b Axle Load Measurement

Displaying and processing in series for measuring the axle loads of a vehicle and for recording them with the licence number.

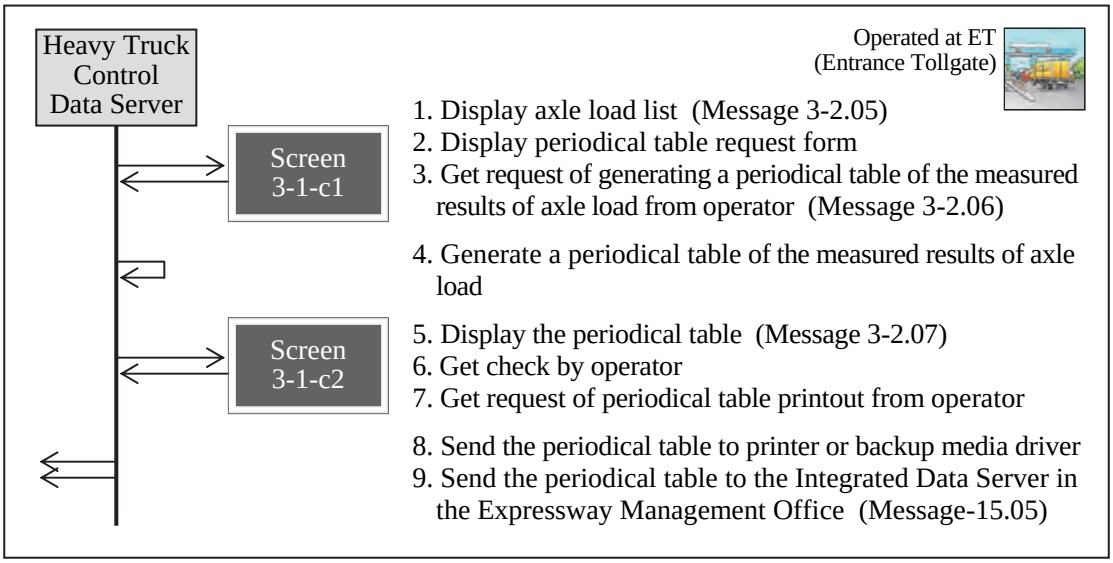
Figure 7.82 Axle Load Measurement



3-1-c Axle Load Listing

Displaying and processing in series for creating a list of the axle load measurement results.

Figure 7.83 Axle Load Listing

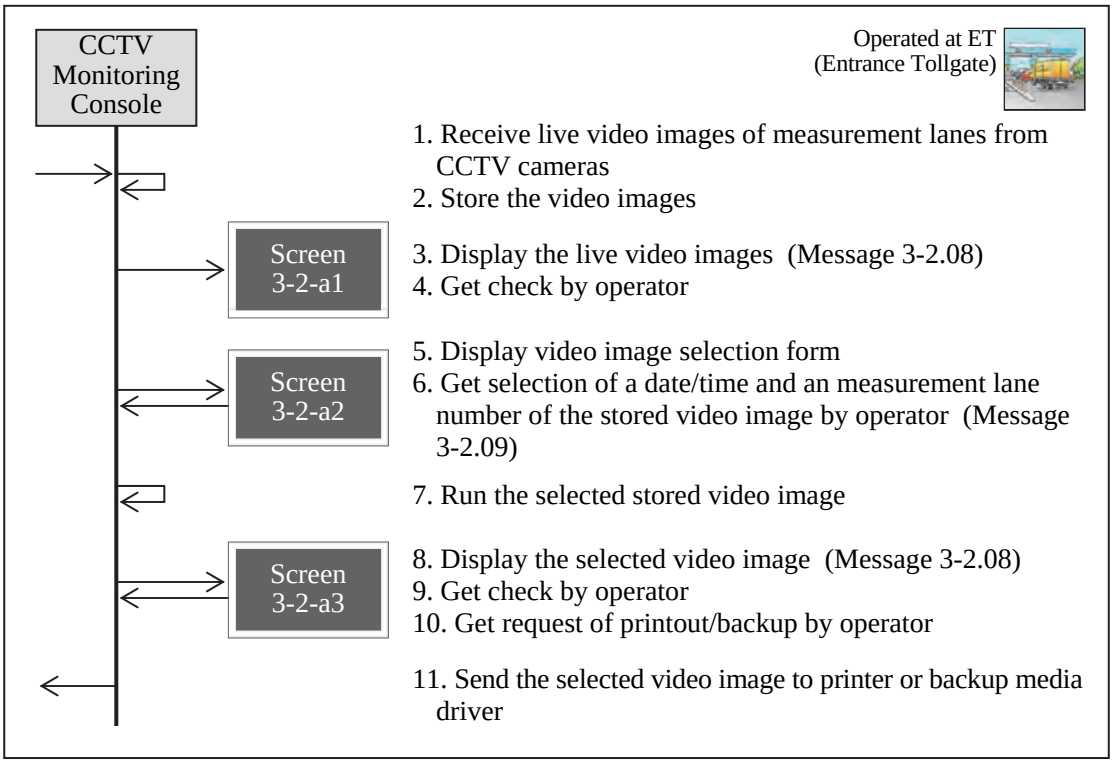


2) CCTV Monitoring Console (ET)

3-2-a Measurement Lane Monitoring

Displaying and processing in series for confirming, by CCTV Cameras, the conditions of vehicle passages and the axle load measurement activities at each axle load measurement lane.

Figure 7.84 Measurement Lane Monitoring



Note: The video image is to be stored/displayed together with the indication from the Heavy Truck Control Data server.

7.6.2 Major Message List

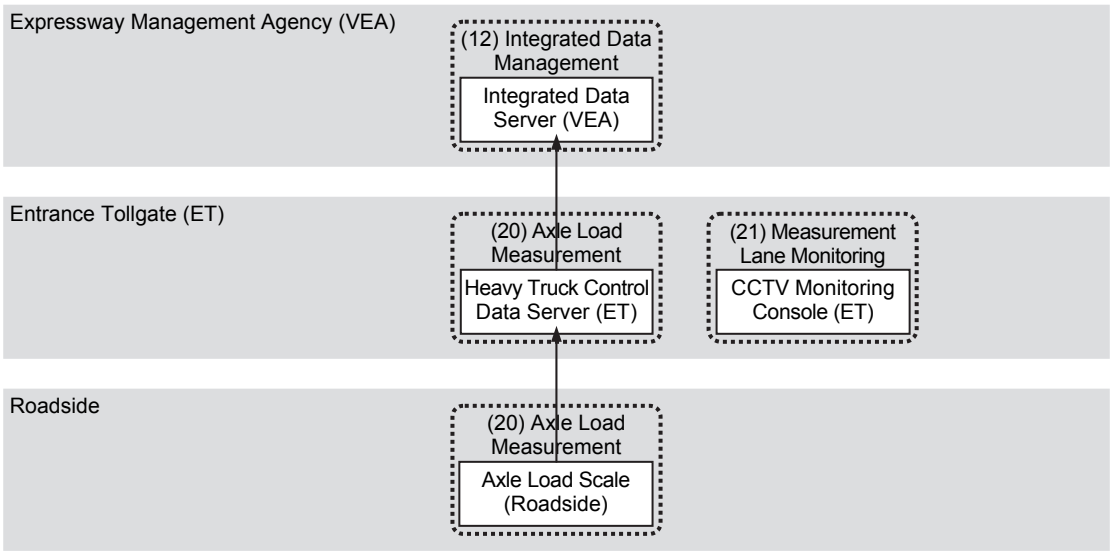
The major message for vehicle weighing system is shown in the list below.

Table 7.8 Major Message List of Vehicle Weighing System

Message	Transmitter (Equipment Component)	Receiver (Equipment Component)	Major Data Sets to be Included
Message 3-1.01	Data Input Device	Heavy Truck Control Data Server (ET)	Axle Load Measurement Data Set
Message 3-2.01	Mobile Terminal	Heavy Truck Control Data Server (ET)	License Plate Data Set
Message 3-2.02	License Plate Scanner (Roadside)	Heavy Truck Control Data Server (ET)	Axle Load Management Data Set
Message 3-2.03	Axle Load Scale (Roadside)	Heavy Truck Control Data Server (ET)	
Message 3-2.04	Heavy Truck Control Data Server (ET)	Monitor Screen	
Message 3-2.05	Heavy Truck Control Data Server (ET)	Monitor Screen	
Message 3-2.06	Data Input Device	Heavy Truck Control Data Server (ET)	
Message 3-2.07	Heavy Truck Control Data Server (ET)	Monitor Screen	
Message 3-2.08	Heavy Truck Control Data Server (ET)	Monitor Screen	
Message 3-2.09	Data Input Device	Heavy Truck Control Data Server (ET)	
Message 1-15.05	Heavy Truck Control Data Server (ET)	Integrated Data Server (VEA)	

Source: ITS Integration Project (SAPI) Study Team

Figure 7.85 Message Exchange among Major Equipment Components



Note, VEA: Expressway Management Agency, ET: Entrance Tollgate.

7.6.3 Primary Data Dictionary

The primary data dictionary for the major data sets of vehicle weighing system is shown in the table below.

Figure 7.9 Primary Data Dictionary for Vehicle Weighing System

	Major Data Set <Origin>	Data Elements	Type	Digit	Set	Update Cycle	Storage Period for Origin	Definition
31	Axle Load Measurement Data Set <G -Axle Load Scale>	Road Section ID	INT*	4	1	When overloading data detected	6 months	An unique identifier of the road section where the axle load scale installed
		Axle Load Scale Location ID	INT*	4	1			An unique identifier of install location of axle load scale
		Lane ID	INT*	2	1			An unique identifier of the lane of axle load scale (Numbered from the median)
		Number of Axles	INT*	2	1			Number of axles (less than or equal to 10)
		Axle Load	INT*	2	10			Measurement data of load of an axle (unit: Ton)
		Maximum Axle Load	INT*	2	1			Maximum value of measured axle loads of a vehicle (unit: Ton)
		Axle Load Status	INT*	2	1			Status of the axle load scale: - 0: Normal - 1: Suspicious at overloading - 2: Overloaded
		Serial Number of Vehicle	INT	5	1			Daily serial number for a vehicle passing through the axle load scale. (For reference to other data set)
		Date/Time	Datetime	≥14	1			Year/ month/day/hour/minutes/second of generating data set
32	Axle Load License Plate Data Set <G -Image Processor>	Road Section ID	INT*	4	1	When overloading data detected	6 months	An unique identifier of the road section where the axle load scale installed
		Axle Load Scale Location ID	INT*	4	1			An unique identifier of install location of axle load scale
		Lane ID	INT*	2	1			An unique identifier of the lane of axle load scale (Numbered from the median)
		Roadside Equipment ID	INT*	4	1			An unique identifier of a license recognition device
		Captured License Plate Number	TXT	12	1			License plate number recognized by image processor
		Captured License Plate Image	IMG	var	1			The license plate image captured by CCTV camera
		Serial Number of Vehicle	INT	5	1			Daily serial number for a vehicle passing through the axle load scale. (For reference to other data set)
		Date/Time	Datetime	≥14	1			Year/ month/day/hour/minutes/second of generating data set
33	Axle Load Management Data Set <G/C-Server>	Road Owner ID	INT*	4	1	Hourly	1 year	An unique identifier of a road owner
		Road Section ID	INT*	4	1			An unique identifier of the road section where the axle load scale installed
		Axle Load Scale Location ID	INT*	4	1			An unique identifier of install location of axle load scale
		Lane ID	INT*	2	1			An unique identifier of the lane of axle load scale (Numbered from the median)
		Date/Hour of Record	TXT	10	1			Day/month/year/hour of the record
		Number of Heavy Trucks	INT	5	1			Number of heavy trucks measured
		Number of Suspicious Trucks	INT	5	1			Number of heavy trucks suspicious at overloading
		Number of Overloaded Trucks	INT	5	1			Number of heavy trucks overloaded
		Axle Load Measurement Data Set	Set	var	N			Axle load measurement data set of vehicle passing through axle load scale
		Axle Load Status	INT*	2				Status of the axle load scale: - 0: Normal - 1: Suspicious at overloading - 2: Overloaded
		Serial Number of Vehicle	INT	5				Daily serial number for a vehicle passing through the axle load scale. (For reference to other data set)
		Date/Time	Datetime	≥14	1			Year/ month/day/hour/minutes/second of generating data set

Note: IMG: Image, TXT: Text, FLOAT: Floating-point complex number, INT: Integer, INT*: Short integer, I: Input, G: Generated, C: Checked, R: Recorded.

Source: The Study Team

8. Procedures of Communication System Operation/Management

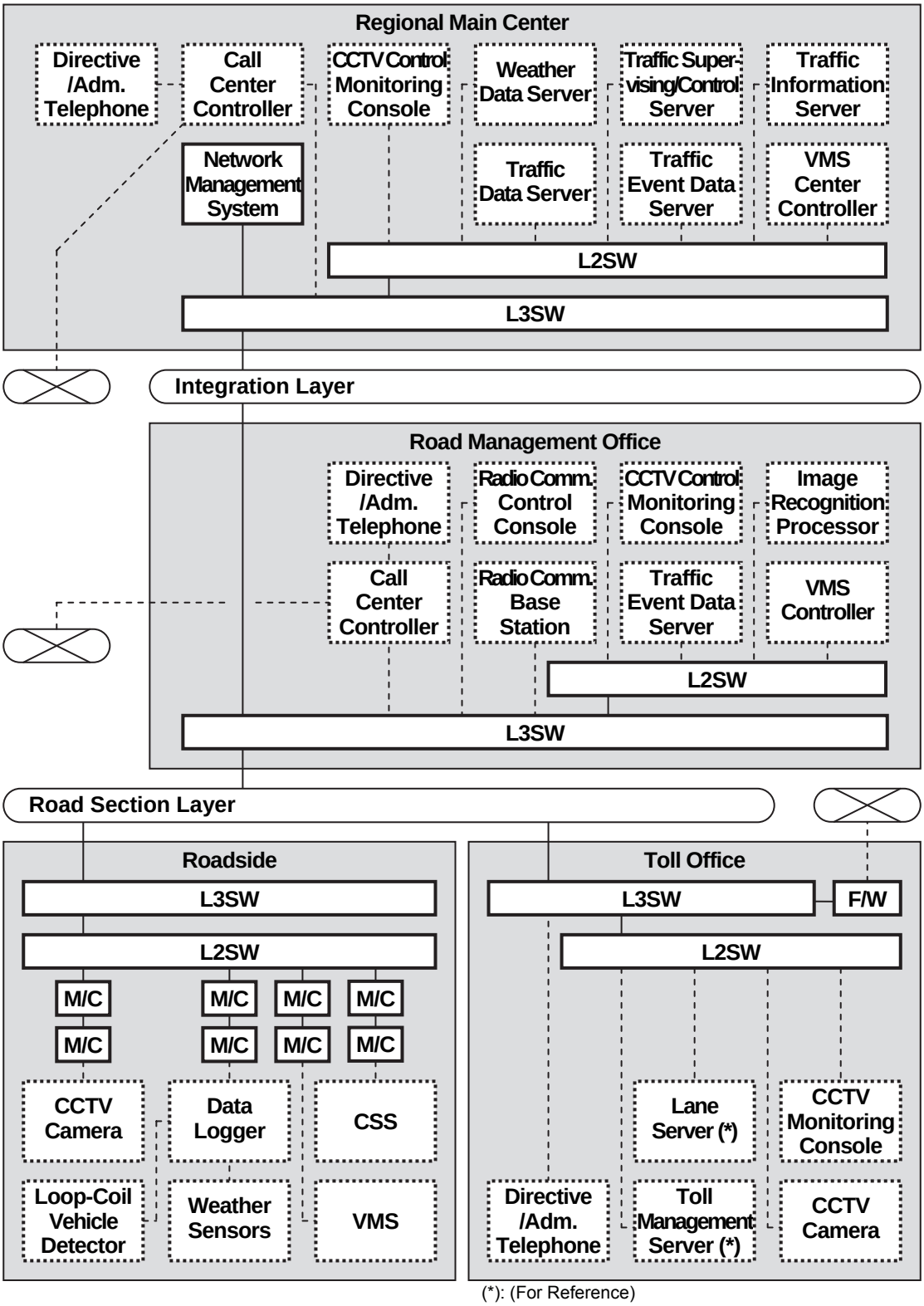
8.1 General

This system monitors a condition and resource and performance of communication network. In addition, this system switch network to redundant component automatically, and it tests communication line.

8.2 System Architecture

The system is to be composed as shown in the following system architecture.

Figure 8.1 System Architecture for Communication System



(*): (For Reference)

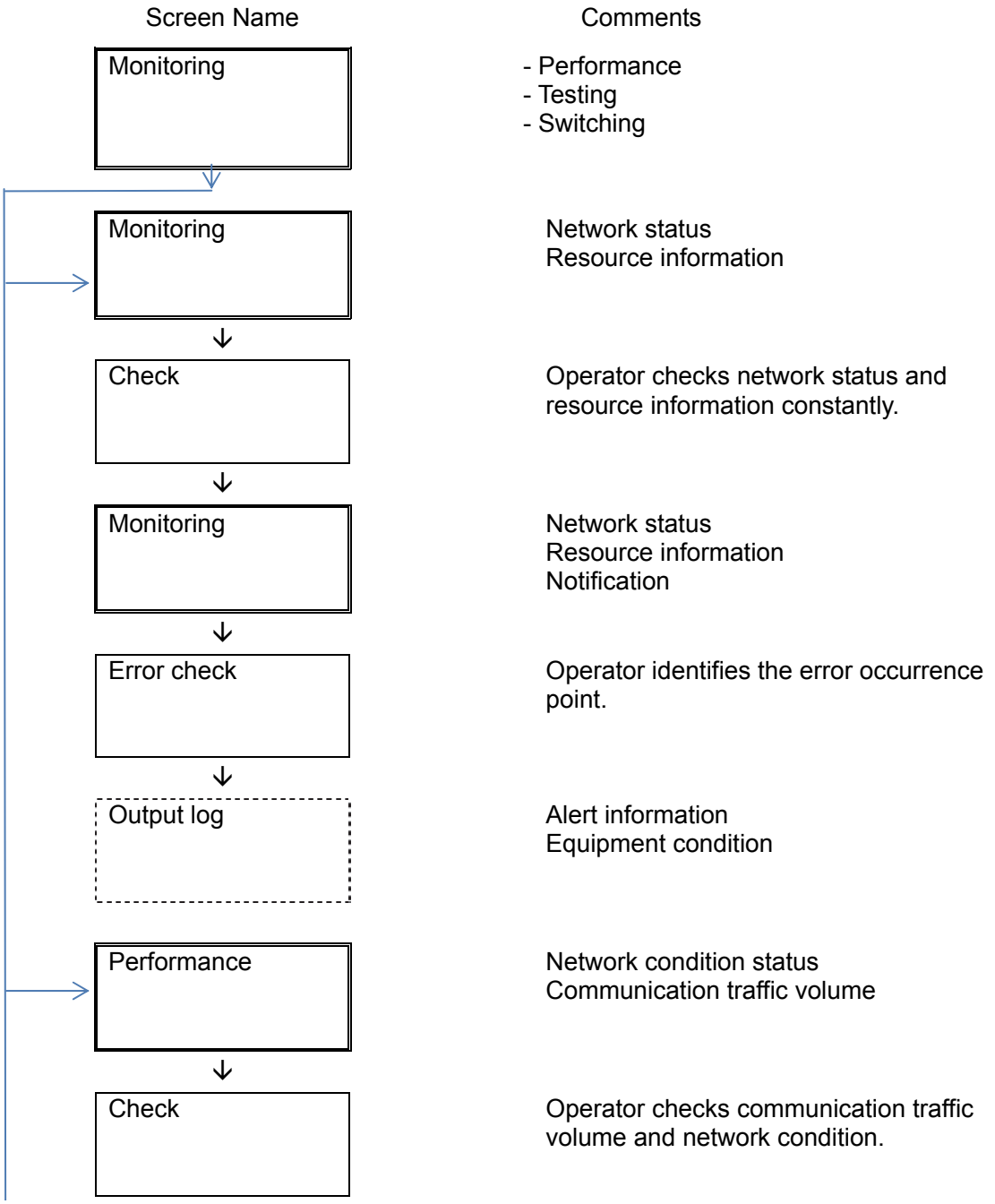
8.3 Processing/Screen Transition Diagram

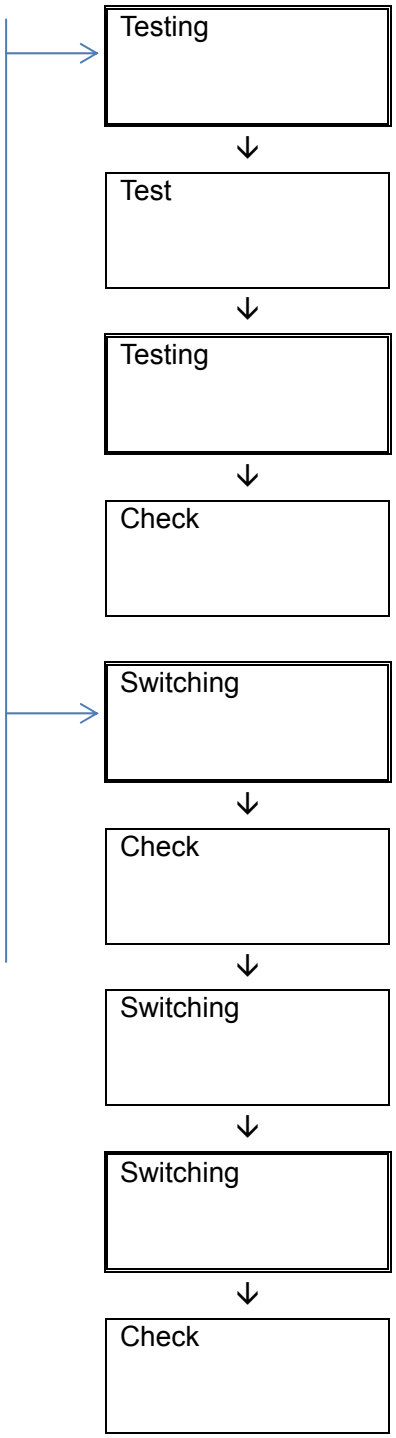
Network Management System Console (RMC)

4-1-a Network Monitoring

This screen displays status of the network connection and resource. About performance and testing and switching, is displayed as additional screen.

Figure 8.2 Network Monitoring





Equipment information
Test result (Blank)

Operator chooses equipment and start test.

Equipment information
Test result (update)

Operator checks result.

Network structure image
Connection information (current situation)

Operator checks connection status of the network.

Operator switches present network to the redundant equipment component.

Network structure image
Connection information (update situation)

Operator checks the network switched.

8.4 Comment Indication

The network management system displays a message on screen at every processing. A list of comments to be indicated on each screen is shown in table below.

Table 8.1 Comments Indication for Network Management System

Screen Number	Comment Indication
B0110000	Getting network information.
	The network information cannot be collected by the system.
	Logon failure: unknown user name or bad password.
	Logon failure: user not allowed to log on to this computer.
	An unexpected error occurred.
B0111000	The network is operating successfully.
	The error on the network occurred.
	Access is denied.
B0111100	The network is operating successfully.
	There is heavy load on the network.
	A network was disconnected.
B0111200	The system is sending test data to all equipment components.
	The test was completed successfully.
	Access is denied.
B0111300	The network is switched.
	The network switched redundant equipment component successfully.
	Access is denied.

8.5 Output Log

The network management system outputs several log. The format of the log file is output by a file name called "***.log" with a text format. Contents of each log file are to be output as shown in table below.

Table 8.2 Output Log of Network Management System

Log Name	Contents of Log	Type
Event Log	The system outputs normal information in this log file when the processing of the event is exactly finished.	TXT
Error Log	The system outputs the information in this log file when it detects an error in a network.	TXT
Test Log	The system outputs the result of the test function that an operator executed in this log file.	TXT
Performance Log	The system outputs performance information in this log file at regular interval	TXT
Security Log	The system outputs security information in this log file at regular interval in monitoring information of the outside connect.	TXT

9. Procedures of Related System Operation and Maintenance

9.1 General

The following procedures of related system operation and maintenance are to be mentioned in this chapter:

- Operation for Internet
- Operation of OBU (*)
- Operation of prepaid IC-card (*)
- Operation for toll settlement (*)
- Operation for overloading regulation
- System maintenance.

Note, (*) : (For Reference)

9.2 Operation for Internet

Since the traffic information of the internet must be provided based on a wide area, the internet management must be handled based on display of nationwide unification. The following items are minimum requirements:

- To prepare the Internet Management Manual for all equipment components and devices, and to perform the management base on them.
- To prepare the Internet provision Manual for all traffic information, and to perform the operation base on them.
- To maintain the display of the latest traffic information on the most updated condition at the central.
- To send the traffic information data to the Web server immediately upon processing traffic events.

9.3 Operation of OBU (For Reference)

Since the OBU must be issued based on the vehicle license plate number, one-to-one basis, the OBU management must be handled based on the nationwide common procedures. The following items are minimum requirements:

- To prepare the OBU Management Manual for all equipment components and devices, and to perform the management base on them.
- To maintain the invalidation list on the most updated condition at the central, in order to avoid duplication.
- To send the up-dated invalidation list from the central to all toll offices on a regular basis for regular updating purpose.
- To send the up-dated invalidation list from the central to all toll offices, when the central updated irregularly, such as upon receiving a request from OBU users due to stolen.
- To inform the OBU Management center immediately, when suspicious usage of OBU is observed.

- To report the registration information to the Vietnamese authorities in charge upon their demand.

9.4 Operation of Prepaid IC-card (For Reference)

The prepaid IC –card must be handled based on the requirement of card issuer(s). The following items are minimum requirements.

- To prepare the Prepaid IC-card Handling Manual at the toll gates and the toll offices based on the requirements of card issuer(s).
- To update the invalidation list at the roadside equipment immediately upon receiving the list from the card-issuer(s).
- To inform the card-issuer(s) immediately, when suspicious usage of card is observed.

9.5 Operation for Toll Settlement (For Reference)

The toll settlement must be conducted by the settlement bank(s). The data related to the settlement must be handled based on the requirement of card issuer(s). The following items are minimum requirements.

- To send the transaction data to the settlement bank(s) immediately upon processing events such as toll collection and cards recharging.

9.6 Operation for Overloading Regulation (For Reference)

The overloading regulation must be conducted by the traffic inspector. The regulation must be handled based on the requirement of law. The following items are minimum requirements.

- To prepare the Overloading Regulation Manual for all equipment components and devices, and to perform the management base on them.

9.7 System Maintenance

The policy for system maintenance is to be described as follows:

- To prepare the Maintenance Schedule and the Maintenance Manual for all equipment components and devices included in the Traffic Information/Management System, the Vehicle Weighing System and the Communication System, and to perform the maintenance base on them.
- To perform periodic maintenance on the server system in the Regional Main Center, the road management offices and the toll offices to ascertain the good condition without abnormalities.
- To make a backup of all the data stored in the server system using suitable recording media. Additionally, to check missing of detected data, to restore the lost data and to maintain the availability of the data.
- To store needed quantity of consumables to ensure continuous operation of the system.
- To perform visual observation of roadside equipment included in the Traffic Information/ Management System, and the Vehicle Weighing System by routine patrol to ascertain

the good condition without any damage/ abnormalities on the roadside equipment proper or the base structure.

- To perform visual observation of the Communication System by routine patrol, as well as detection by NMS (Network Management System), to ascertain the good condition without any damage/abnormalities on the cable, the communication node or the duct.
- To make contact/inquiry from the Regional Main Center to the road management offices, in the case that an abnormality is identified remotely in the Regional Main Center including the case of detection by NMS, to confirm the existence of reason on the road section layer.
- To make report from the road management office to the Regional Main Center in the case that an abnormality is identified in the road management office including the case of detection by NMS.

Specific Maintenance for Respective Road Sections

According to the official letter of the Government of Viet Nam dated May 22, 2012 with Ref. No. 3569/VPCP-KTN, the Government of Vietnam agreed with the policy that MOT should cooperate with VNPT to install communication infrastructures (optical fiber cable and auxiliaries and services). Based on this official letter, optical fiber cable for Ha Noi – Bac Giang expressway section is planned to install by Vietnam Telecoms National (VTN) that is the subsidiary of VNPT. However, other expressway section, there is no official letter so far. Therefore, if we mention "VTN (not decided yet)" in the following table, it means that there is no official letter so far but if we consider the government's policy, VTN seems to be suitable organization.

VTN will install and maintain the main optical fiber cable only. The connecting faiber cable between the roadside equipment and the main cable should be installed by the contractor. Maintenance responsible organization is also the same demarcation of installation work.

Table 9.1 Responsible Organizations on Communication System

	Expressway Section	Installation	Operation (NMS Monitoring)	Maintenance
1	RR3	Contractor	HDOT or O&M Company	O&M Company
2	Phap Van – Cau Gie	Contractor and VTN (not yet fixed)	BOT Investor or O&M Company	O&M Company and VTN (not decided yet)
3	Cau Gie – Ninh Binh	Contractor and VTN (not yet fixed)	VEC O&M	VEC O&M and VTN (not decided yet)
4	Ha Noi – Bac Giang	Contractor and VTN	BOT Investor or O&M Company	O&M Company and VTN
5	Noi Bai – Ca Lo Bridge	Contractor	HDOT or O&M Company	O&M Company
6	Ca Lo Bridge – Bac Ninh	Contractor	BNDOT or O&M Company	O&M Company
7	Lang – Hoa Lac	Contractor	HDOT or O&M Company	O&M Company
8	Integration Layer Network	Contractor	O&M Company	O&M Company

Source: The Study Team

10. Basic Policy on Setting-up of Operational Structure and Training

10.1 General

In this chapter, the following items are to be discussed and described:

- Objectives of training
- Training program
- Implementation procedure of training
- System maintenance

10.2 Stepwise Setting-up of Operational Structure

1) Institutional Arrangement for System Operation

The institutional arrangement recommended for operating the System installed in the Northern Regional Main Center and the 7 expressway sections are summarized in table below.

Table 10.1 Institutional Arrangement for System Operation

	Existing Contract Type of O&M	Public Road Owner or Investor	Road Operator
Northern Regional Main Center	--	VEA	VEA
Ring Road 3 **	Service Contract	HPC	O&M-Company
Lang – Hoa Lac	Service Contract	HPC	O&M-Company
Phap Van – Cau Gie **	Concession Contract	DRVN/BOT	BOT
Cau Gie – Ninh Binh ***	Service Contract	VEC	VEC-O&M
Ha Noi – Bac Giang	Concession Contract	DRVN/BOT	BOT
Noi Bai – Ca Lo Bridge	Service Contract	Bac Ninh Prv.	O&M-Company
Ca Lo Bridge – Bac Ninh	Service Contract	HPC	O&M-Company

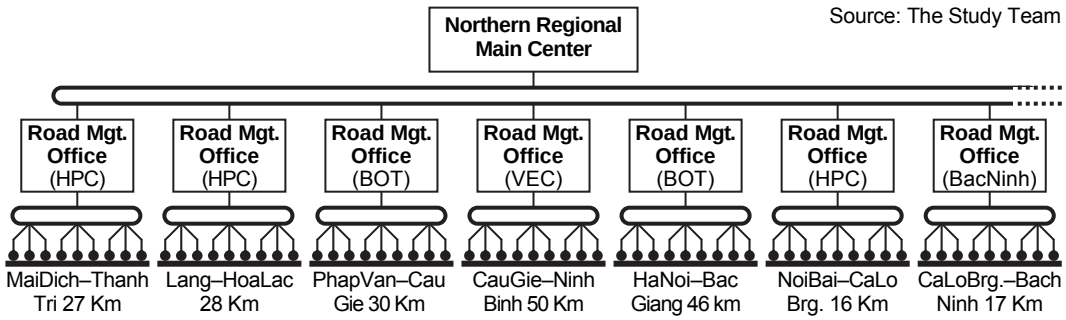
Note, **: ITS is partially installed already by JICA Grant, ***: ITS is partially installed already.

2) Stepwise Setting-up of Operational Structure

The structure shown in the figure below is originally recommended for operating the System installed in the Northern Regional Main Center and the 7 expressway sections.

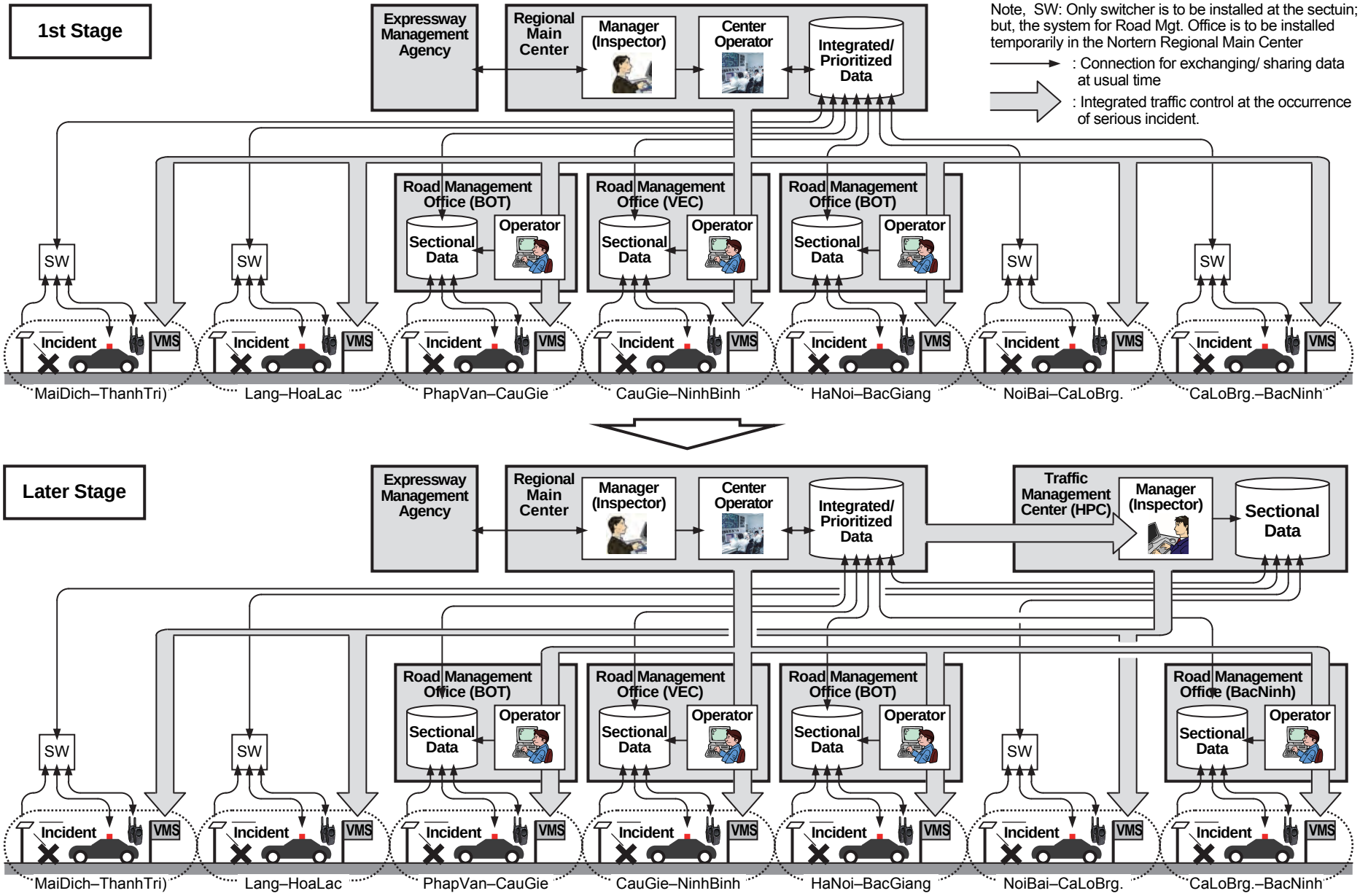
Figure 10.1 Originally Recommended Operational Structure

Source: The Study Team



However, the stepwise setting-up of operational structure is required as illustrated in the preceding page; because HPC and Bac Ninh Provice have not developed their specific plans for implementing the road management offices.

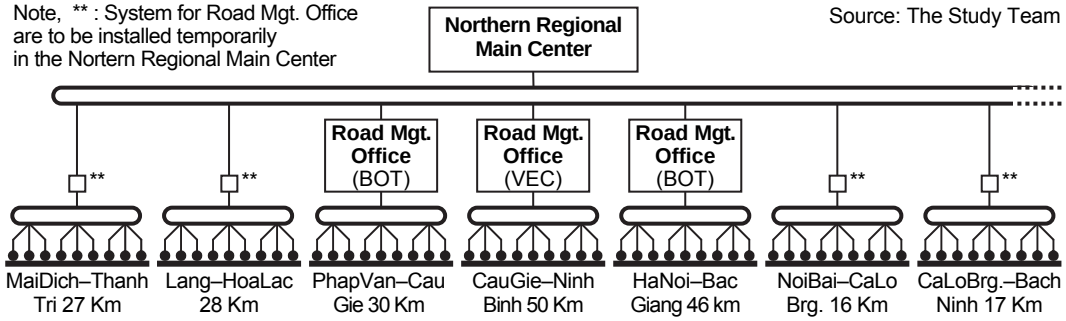
Figure 10.2 Conceptual Illustration of Stepwise Setting-up of Operational Structure



Source: The Study Team

The originally recommended operational structure it to be modified accordingly, as showni in the figure below, for the 1st stage immediately after completion of the Project. The systems for the road management offices for the sections of Mai Dich–Thanh Tri (Ring Road 3), Lang–Hoa Lac, Noi Bai–Ca Lo Bridge and Ca Lo Bridge–Bach Ninh are to be installed temporarily in the Northern Regional Main Center

Figure 10.3 Operational Structure in the 1st Stage



3) Operational Structure in the 1st Stage

The system installed by the Project is to be utilized for the expressway operation. For this purpose, the organizations and systems of road management offices need to be integrated and cooperated. The operational structure for the expressway sections in the Project Area is illustrated in the following page: the road management offices are to be integrated under the Northern Regional Main Center.

The Northern Regional Main Center is owned and operated by the Expressway Management Agency and comprises the units of center operators, system maintenance, administration and others under the General Manager.

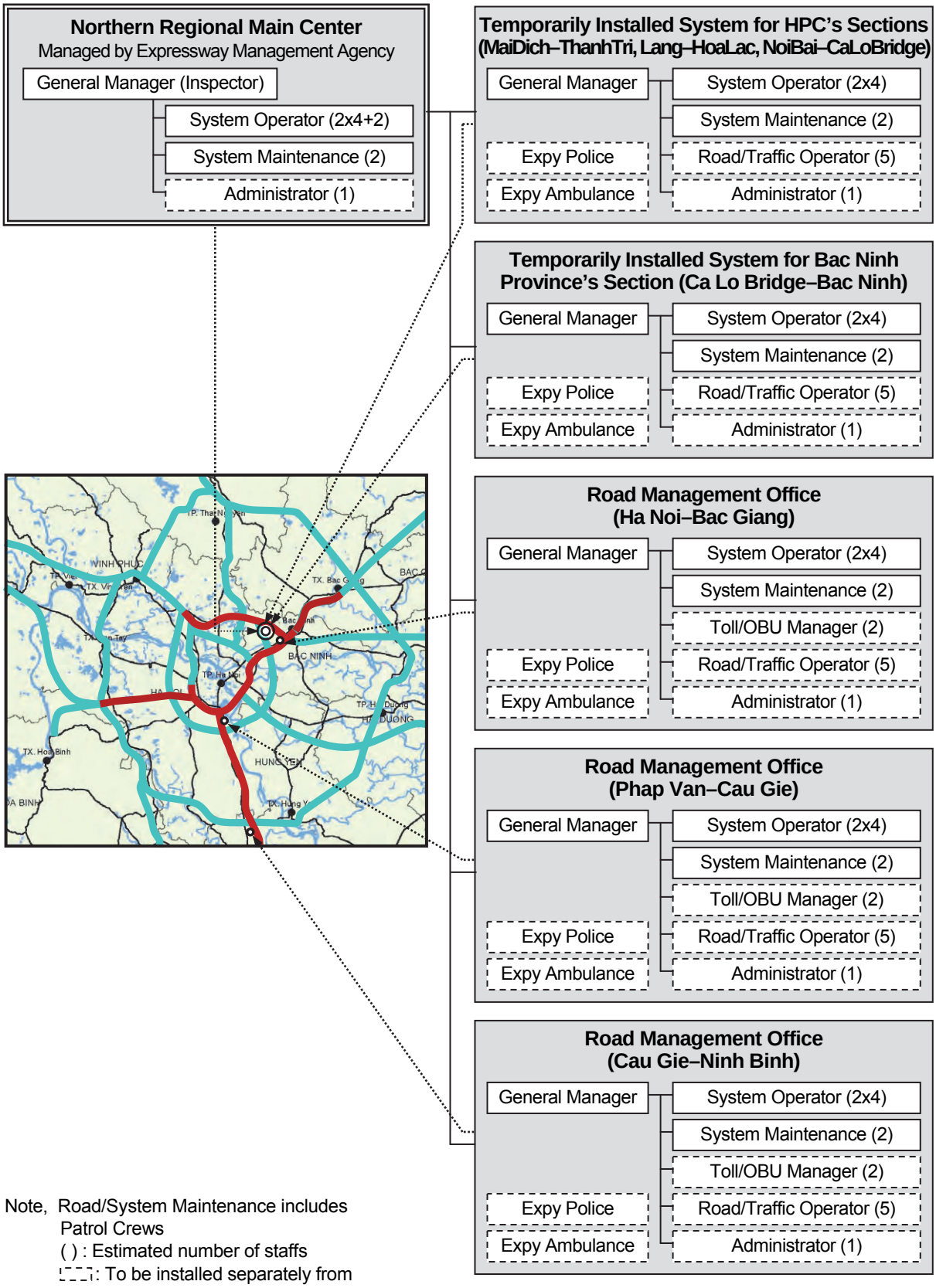
Each road management office is operated by the staffs of road operator which comprise the units of system operators, system maintenance and road/traffic operators, and administration and others under the General Manager. The expressway sections in the Project Area are operated respectively by the Road Owners as shown below.

- BOT: Phap Van – Cau Gie and Ha Noi – Bac Giang
- VEC-O&M: Cau Gie – Ninh Binh
- O&M company: Mai Dich – Thanh Tri, Lang – Hoa Lac, Noi Bai – Ca Lo Bridge and Ca Lo Bridge – Bac Ninh.

In the road management office, the unit of road/traffic operators includes the patrol crews. The patrol crews are to perform the activities in a team with the expressway police and the expressway ambulance.

The basic policy and the discussion results of the framework of expressway operation using ITS are shown in Chapter 5 and respective roles of the Expressway Management Agency and the Public Road Owners and Investors are mentioned in Chapter 5 and Appendix-1.

Figure 10.4 Organizations of Northern Regional Main Center and Road Management Offices



Note, Road/System Maintenance includes Patrol Crews
( ) : Estimated number of staffs
[ ] : To be installed separately from the Project.

Source: The Study Team

10.3 Operating Organizations

The system is to be operated and maintained by the following organizations:

- Expressway Management Agency
- Public Road Owners and Investors (VEC, HPC and Bac Ninh Province)
- Road Operators (VEC-O&M and other O&M-Companies)
- Telecom Service Company.

1) Expressway Management Agency

(1) Roles

The roles below are to be fulfilled by the Expressway Management Agency for system operation. Details of the roles and operation framework are shown in Chapters 4 and 5.

- Ownership/funding of the Regional Main Center
- Operation/maintenance of hardware/software of ITS
- Regulation on hardware/software in compliance with the ITS Standards
- Monitoring of the whole expressway network in the Regional Main Center
- Exchange monitored information/data of traffic conditions/events
- Guidance to the road management offices for integrated/prioritized information dissemination in the event of serious incident
- Decision to enforce a serious traffic restriction, such as closure, in consideration of the integration over different expressway sections
- Integrated management on the data from traffic information/ control
- Development of inspection/budget plan of expressway improvement/maintenance
- Evaluation of road operator's achievement in the expressway operation.

(2) Capability of System Operation

MOT has experience in the management of expressway operation for the following sections:

- HCMC – Trung Luong Expressway (based on the Decision No.195/QD-BGTVT)
- Cau Gie – Ninh Binh Expressway (based on the Decision No. 2451/QD-BGTVT).

MOT has experience in the management of overloading regulation based on the Circular No.07/2010/TT-BGTVT.

(3) Needed Training

Preparatory for the training, basic information on the specific operation of equipment components is to be provided by the operation manuals provided by the contractor.

Training on the following items are to be provided for the manager in the Regional Main Center using the installed systems in the Project:

- Proper monitoring and judging gravity of incident using roadside equipment of Traffic Information/Control System
- Proper operation of data management and exchange among expressway operators using Traffic Information/Control System
- Proper operation of incident clearance in cooperation with related organizations using Traffic Information/Control System

- Proper operation of information dissemination by VMS in cooperation with related expressway sections using Traffic Information/Control System.

Details of the training program including trainees are to be hereinafter mentioned.

2) Public Road Owners and Investors (DRVN, VEC, HPC and Bac Ninh Province)

(1) Roles

The roles below are to be fulfilled by the Public Road Owners and Investors for system operation. Details of the roles and operation framework are shown in Chapters 4 and 5.

- Ownership/funding of road structure/facilities other than ITS
- Ownership/funding of facilities of ITS
- Operation/maintenance of hardware/software of ITS (in the case of service contract)
- Submission of the application for utilization of radio frequency.

The technical, technological and environmental department is responsible for system O&M.

(2) Capability of System Operation

VEC has the following experiences in the expressway operation in the section of Cau Gie – Ninh Binh based on the Decision No. No. 2451/QD-BGTVT:

- Expressway operation preparing the special telephone number 19001838
- Cooperation with expressway police and ambulance for incident clearance

They established a road management office for expressway operation at Vuc Vong.

VEC has a sufficient number of university-educated information/communication engineers who have enough capability to operate ITS.

(3) Needed Training

Preparatory for the training, basic information on the specific operation of equipment components is to be provided by the operation manuals provided by the contractor.

Training on the following items are to be provided for the operators in the Regional Main Center and road management offices and the patrol crews using the traffic information/control system installed in the Project:

- Proper monitoring and judging gravity of incident using roadside equipment of Traffic Information/Control System
- Proper operation of data management and exchange among expressway operators using Traffic Information/Control System
- Proper operation of incident clearance in cooperation with related organizations using Traffic Information/Control System
- Proper operation of information dissemination by VMS in cooperation with related expressway sections using Traffic Information/Control System.

Training on the following item is to be provided for the operators and the maintenance crews in the Regional Main Center and road management offices using the system installed in the Project:

- Proper/prompt recovery work of the system by identifying fault location on the communication network of ITS.

Details of the training program including trainees are to be hereinafter mentioned.

3) Road Operators (VEC-O&M and Other O&M-Companies)

(1) Roles

The roles below are to be fulfilled by the Road Operators for system operation. Details of the roles and operation framework are shown in Chapters 4 and 5.

- Funding of facilities of ITS (in the case of concession contract)
- Operation/maintenance of hardware/software of ITS
- Acquisition of information through the special call number or sensors of ITS
- Traffic event data input at the road management office or roadside and sharing them with the Regional Main Center and other organizations
- Traffic information/control of an expressway section
- Dispatch of a patrol crew to the incident site
- Identification of the situation/gravity of an incident
- Enforcement/removal of a traffic restriction
- Incident handling/clearance works

(2) Capability of System Operation

VEC-O&M has the following experiences in the expressway operation in the section of Cau Gie – Ninh Binh based on the Decision No. No. 2451/QD-BGTVT:

- Expressway operation preparing the special telephone number 19001838
- Cooperation with expressway police and ambulance for incident clearance

VEC-O&M has a sufficient number of university-educated information/communication engineers who have enough capability to operate ITS.

(3) Needed Training

Preparatory for the training, basic information on the specific operation of equipment components is to be provided by the operation manuals provided by the contractor.

Training on the following items are to be provided for the operators in the Regional Main Center and road management offices and the patrol crews using the traffic information/control system installed in the Project:

- Proper monitoring and judging gravity of incident using roadside equipment of Traffic Information/Control System
- Proper operation of data management and exchange among expressway operators using Traffic Information/Control System
- Proper operation of incident clearance in cooperation with related organizations using Traffic Information/Control System
- Proper operation of information dissemination by VMS in cooperation with related expressway sections using Traffic Information/Control System.

Training on the following item is to be provided for the operators and the maintenance crews in the Regional Main Center and road management offices using the system installed in the Project:

- Proper/prompt recovery work of the system by identifying fault location on the communication network of ITS.

Details of the training program including trainees are to be hereinafter mentioned.

4) Telecom Service Company

(1) Roles

The roles below are to be fulfilled by the Telecom Service Company for system operation. Details of the roles and operation framework are shown in Chapters 4 and 5.

- Funding/maintenance of facilities of trunk communication system of ITS
- Operation of trunk communication system of ITS.

(2) Capability of System Operation

Telecom service companies have suffucient experience for operating and maintaining the trunk communication system of ITS.

10.4 Objectives of Training

1) Background

The systems to be introduced under ITS Integration Project are Traffic Information/Control, Automated Toll Collection, and Axle Load Measurement which is considered high priority as ITS user services.

In order to start up smooth operation of those system and to ensure the sustainability of the cooperation outcome of the ITS Integration Project, the following training is required.

(1) Training for instructor of expressway traffic control operator
(2) Training for system operation and maintenance focusing on Traffic Information/Control
(3) Training of lane control related to automated toll collection and axle road measurement

Although the traffic control system will be developed under the grant aid project by the government of Japan titled “The Project for Development of Traffic Control System for Expressway in Hanoi”, the Traffic Information/Control System to be introduced in the Northern Regional Main Center under the ITS Integration Project, is the first and not familiar system for the person who operates it as expressway traffic control operator basically. Upon the introduction of the traffic Information/Control System, operation guidance for each equipment component is required to implement by the contractor or manufacturer of the equipment component. However, in order to control expressway traffic timely and properly by the expressway traffic control operator, it is required to disseminate necessary information to the VMS or CSS based on the operator’s judgement on the basis of guidance provided by the Traffic Information/Control System which is processed by the collected information from the roadside equipment components.

For realizing such conditions, the following training is required to implement for smooth operation start-up, and ensuring sustainability of cooperation result to be achieved under the ITS Integration Project. The training is recommended to implement for the following two stages.

a) The first Stage: Basic program for expressway traffic control operator, system maintenance staff, and other related organizations staff
b) The Second Stage: advanced program of on the job training basis for expressway traffic control operator to be advised by the expert of expressway traffic control

The expressway traffic control operator will enhance his capability through actual traffic control experience using the Traffic Information/Control System. However, it is necessary to get the advice from the traffic control expert during actual operation for more precise traffic control capability. In fact in Japan, the expressway traffic control operator is trained through such process. Furthermore such advice becomes more important during rainy season since traffic accident increases during such season. In order to ensure the sustainability of the cooperation outcome of the ITS Integration Project, the cooperation on advice by the expert during traffic control operation is required.

As for the training for operation and maintenance, it is necessary for operator who faces failure of the system or who find extraordinary data to be able to operate the system properly.

It is different from the initial operation guidance to be provided by the manufacturer of the equipment components.

For the training of lane control, it is necessary for the driver who is not familiar to pass toll gate or axle load scale to guide the lane, or in order to prevent to pass the fraudulence driver.

2) Objectives

The objectives of the training are shown below, which are to be specified for individual training items based on the manuals. The list of manuals to be provided by the contractor are shown in the following chapter.

(1) Training on Traffic Control of Expressway

The objective of this training is basic knowledge transfer for the operator of traffic information/ control system responding to the occurrences of incidents for first stage, and enhancement of capability of traffic control for second stage through the process of obtaining advice from traffic control expert during actual traffic control operation in rainy season.

(2) Training on System Operation/Maintenance

The objective of this training is basic knowledge transfer for the responsible staff of system operation and maintenance. The targets are the traffic information/control system.

(3) Training on Lane Operation

The objective of this training is basic knowledge transfer for the responsible staff on the lane operation for vehicle weighing. The target includes the drivers who are not familiar to pass the toll gate and how to prevent the passage of fraudulence driver.

10.5 Training Program

1) Training Items/Contents

The training program is shown below. As for the program (1) to (4), it is planned mainly for the subjects for traffic control staff, and for the program (5) to (9), it is planned mainly for lane operation staff. As for the program (10) to (11), it is planned for the system maintenance staff.

The second stage training is planned for further skill enhancement for traffic control staff. The training will be implemented on the job training basis with obtaining advice from traffic control expert. This stage trainee should master the program (1) to (3) shown in the following table in advance at least.

Table 10.1 Training Items/Contents

Training Items	Contents of Program
(1) Proper monitoring and judging gravity of incident using roadside equipment of Traffic Information/ Control System	- Explanation on Expressway Operation Framework using ITS - Instruction by manual on the basic knowledge of Traffic Control System such as information/data collection, information/data processing, information dissemination, and implementation of related exercise - Instruction by manual on the method of event judgement, event recording, and record management, and implementation of related exercise - Instruction on utilization method of data generated by image recognition function using CCTV camera, and implementation of related exercise - Review of manuals or related format according to the training above if necessary - Guidance for technology transfer from trained staff to other staffs
(2) Proper operation of data management and exchange among expressway operators using Traffic Information/ Control System	- Explanation on Expressway Operation Framework using ITS - Instruction by manual on traffic event data management and exchange, and implementation of related exercise - Instruction by manual on event category, event class, criteria of enforcing traffic regulation, and how to make data correlation, and implementation of related exercise - Review of manuals or related format according to the training above if necessary - Guidance for technology transfer from trained staff to other staffs
(3) Proper operation of incident clearance in cooperation with related organizations using Traffic Information/ Control System	- Explanation on Expressway Operation Framework using ITS - Instruction by manual on information distributing procedure and method among related organizations based on the event category which is generated by Traffic Information/Control System, and implementation of related exercise - Instruction on operation of information dissemination equipment components such as VMS controller based on the confirmation result among related organization, and implementation of related exercise - Instruction by manual on record of communication between related organization, record of operation of information dissemination equipment, and implementation of related exercise - Review of manuals or related format according to the training above if necessary - Guidance for technology transfer from trained staff to other staffs

Training Items	Contents of Program
(4) Proper operation of information dissemination in cooperation with related expressway sections using Traffic Information/ Control System	- Explanation on Expressway Operation Framework using ITS - Instruction by manual on information distributing procedure and method among related organizations based on the event category which is generated by Traffic Information/Control System, and implementation of related exercise - Instruction on operation of information dissemination equipment components such as VMS controller based on the confirmation result among related organization, and implementation of related exercise - Instruction by manual on record of communication between related organization, record of operation of information dissemination equipment, and implementation of related exercise - Review of manuals or related format according to the training above if necessary - Guidance for technology transfer from trained staff to other staffs
(5) Proper tollgate lane operation for toll collection under usage of ETC and Touch&Go System	- Instruction of skill on vehicle guidance to the lane of ETC, Touch&Go, and manual at toll gates. - Instruction of skill on proper handling for fraudulence vehicle - Review of manuals or related format according to the training above if necessary - Guidance for technology transfer from trained staff to other staffs
(6) Proper operation of handling the vehicle with balance shortage or without OBU under usage of ETC System	- Instruction of skill on identifying and stopping vehicle with balance shortage or without OBU under usage of ETC System going into lane. - Instruction of skill on futher processing of fraudulence vehicle - Review of manuals or related format according to the training above if necessary - Guidance for technology transfer from trained staff to other staffs
(7) Proper operation of IC-card issuance/ invalidation and toll settlement in cooperation with a bank	- Instruction of skill on managing IC-card issuance information in cooperation with a bank. - Instruction of skill on managing IC-card invalidation information in cooperation with a bank. - Instruction of skill on toll settlement in cooperation with a bank - Review of manuals or related format according to the training above if necessary - Guidance for technology transfer from trained staff to other staffs

Training Items	Contents of Program
(8) Proper operation of OBU registration/ invalidation in cooperation with related organizations	- Instruction of skill on managing OBU registration information in cooperation with related organization. - Instruction of skill on managing OBU invalidation information in cooperation with related organization. - Review of manuals or related format according to the training above if necessary - Guidance for technology transfer from trained staff to other staffs
(9) Proper lane operation for overloading regulation under usage of Axle Load Scale	- Instruction of skill on heavy truck guidance to the axle load scale lane at toll gates. - Instruction of skill on proper handling for fraudulence vehicle - Review of manuals or related format according to the training above if necessary - Guidance for technology transfer from trained staff to other staffs
(10) Proper integrated management on data from Traffic Information/Control, Toll Collection and Vehicle Weighing	- Instruction on data formation, data storage and implementation of related exercise - Instruction on utilization method of data from Traffic Information/Control, Toll Collection and Vehicle Weighing and implementation of related exercise - Review of manuals or related format according to the training above if necessary - Guidance for technology transfer from trained staff to other staffs
(11) Proper/prompt recovery work of the system by identifying fault location on the communication network of ITS	- Confirmation of maintenance manual and various types of forms handed over by the contractor or manufacturer of each delivered equipment component - Instruction by manual on monitoring various types of equipment components, maintenance work in normal operation time, periodical check & cleaning work, and preparation of record of maintenance activities, and implementation of related exercise using installed equipment components - Instruction on trouble shooting method such as recovery method, and deletion method of outlier data when system failure or fault occurs during normal operation and monitoring conditions of the system, and implementation of related exercise using installed equipment components - Instruction on trouble shooting method such as fault location and investigation method, recovery method of failure when IP network system failure or fault is detected, and implementation of related exercise using installed equipment components - Review of manuals or related format according to the training above if necessary - Guidance for technology transfer from trained staff to other staffs

Note: Greyed out area is "Fore Reference".

2) Target Trainees

The trainees and related training item of each trainee is shown below.

Table 10.2 Trainees for Training Items

Training Items	Trainee	
(1) Proper monitoring and judging gravity of incident using roadside equipment of Traffic Information/Control System	Regional Main Center	- Manager - Operator
	Road management office	- Manager - Operator - Patrol crews
(2) Proper operation of data management and exchange among expressway operators using Traffic Information/ Control System	Regional Main Center	- Manager - Operator
	Road management office	- Manager - Operator - Patrol crews
(3) Proper operation of incident clearance in cooperation with related organizations using Traffic Information/Control System	Regional Main Center	- Manager - Operator
	Road management office	- Manager - Operator - Patrol crews
(4) Proper operation of information dissemination by VMS in cooperation with related expressway sections using Traffic Information/Control System	Regional Main Center	- Manager - Operator
(5) Proper tollgate lane operation for toll collection under usage of ETC and Touch&Go System	Toll office	- Toll manager - Toll collector
(6) Proper operation of handling the vehicle with balance shortage or without OBU in ETC Lane	Toll office	- Toll manager - Toll collector
(7) Proper operation of IC-card issuance/ invalidation and toll settlement in cooperation with a bank	Toll office	- Toll manager - Toll operator
	Bank	- Operator
(8) Proper operation of OBU registration/ invalidation in cooperation with related organizations	Toll office	- Toll manager - Toll operator
	OBU Management Center	- Operator
(9) Proper lane operation for overloading regulation under usage of Axle Load Scale	Toll office	- Traffic inspector - Measurement operator
(10) Proper integrated management on data from Traffic Information/Control, Toll Collection and Vehicle Weighing	Regional Main Center	- Manager
(11) Proper/prompt recovery work of the system by identifying fault location on the communication network of ITS	Regional Main Center	- Operator - Maintenance crews
	Road management office	- Operator - Maintenance crews
	Toll office	- Toll operator - Measurement operator

Note: Greyed out area is "Fore Reference".

3) Instruction Method

The instruction is made by lecture and exercise using Traffic Information/Control System to be installed under the ITS Integration Project basically. The reference is made to the manuals or forms to be prepared for this training program, the framework of expressway operation described in the Study Report, and other necessary documents prepared by the lecturer for system maintenance and lane control.

The manuals or forms to be used for the training shall be translated into Vietnamese. The English/Vietnamese interpreter shall be present during training time.

10.6 Implementation Procedure of Training

It is recommended to implement 1 to 2 months for the first stage after completion of ITS Integration Project. For the second stage, it is recommended to implement approximately 1.5 month during incident prone period such as rainy season.

11. Equipment Operation Manual List

11.1 General

The following decision is provided as the manual for essential points of equipment operation:

- Decision No.2452/QD-BGTVT “Approving Alternatives for Management and Temporary Exploitation of Cau Gie – NH 21 Section, the Expressway Cau Gie – Ninh Binh

The manual lists required for the systems below are itemized in the following sections:

- Traffic information/control system
- Toll Collection/Management System (For Reference)
- Vehicle Weighing System
- Communication System

11.2 Manual List for Traffic Information/Control System

The manuals for the following equipment components are required and to be provided by the contractor at the commissioning of the system.

- CCTV Camera PTZ type
- CCTV Camera FIX type
- Media Converter
- Network Video Recorder
- Monitor Screen
- Data Server
- Monitor Controller
- Video Management Software
- Image Recognition Board
- Image Recognition Software
- Loop-Coil Vehicle Detector
- Loop-Coil Controller
- Data Logger for Vehicle Detection
- Media Converter for Loop-Coil Vehicle Detector
- Traffic Volume Calculation Software
- Travel Speed / Congestion Calculation Software
- Collection / Accumulation Software for Traffic Analysis
- Backup Media Drive
- Rain-Gauge
- Wind Sensor
- Visibility Sensor
- Thermometer
- Data Logger for Weather Monitoring
- Data Collection / Accumulation & Alert Isssue
- UPS
- Compiling of Traffic Event Data Software

- Printer
- Collection / Accumulation Software for Traffic Event Data Management
- Generation of Data for Dissemination Software
- Multi Display Control Software
- Multi Display Graphic Board
- Monitor Controller for Traffic Supervision
- Collection / Accumulation Software for Traffic Supervision
- Mobile Data Input Terminal
- Collection / Accumulation Software for VMS Identification
- VMS / CSS Controller Software
- Web Server for Traffic Information
- Collection / Accumulation / Dissemination Software for Traffic Information

11.3 Manual List for Toll Collection/Management System (For Reference)

The manuals for the following equipment components are required and to be provided by the contractor at the commissioning of the system.

- CCTV Camera for Image recognition
- Barcode Reader
- Text Data Indication Processor
- Monitor Screen
- Printer
- Data Server
- CCTV Camera
- Image Recognition Board
- Image Recognition Software
- Management of Vehicle Identification Software
- Entry-Card Issuer
- Toll Due / Paid Sign
- Stop / Go Sign
- Barrier
- Barrier Switch
- Lane Control / Management Software
- OBU
- Roadside Antenna
- Roadside Controller
- IC-Card Reader / Writer
- IC-Card Controller
- Management Software for Toll
- Backup Media Drive
- UPS
- OBU Registration Terminal
- OBU Registration Software
- OBU Management Software

11.4 Manual List for Vehicle Weighing System (For Reference)

The manuals for the following equipment components are required and to be provided by the contractor at the commissioning of the system.

- Barrier Switch
- Data Server
- Measure and Calculation Software for Vehicle Load
- Overloading Determination & Management Software
- Alert for Overloading Management

11.5 Manual List for Communication System

The manuals for the following equipment components are required and to be provided by the contractor at the commissioning of the system.

- Switching HUB
- Administrative Telephone
- Server for Call Control
- GW for PSTN
- Terminal for Directive Communication
- Layer 3 SW
- Layer 2 SW
- Network Management System for Integration Layer
- Radio Communication Console
- Base Station for Radio Communication
- Radio Communication Terminal