MINISTRY OF TRANSPORT, VIETNAM

SPECIAL ASSISTANCE FOR PROJECT IMPLEMENTATION (SAPI) FOR ITS INTEGRATION PROJECT ON NEW NATIONAL HIGHWAY NO.3 & NORTHERN AREA OF VIETNAM

APPENDIX 5

BASIC DESIGN SPECIFICATIONS

AUGUST 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.
NEXCO EAST ENGINEERING CO., LTD.
NIPPON KOEI CO., LTD
TRANSPORTATION RESEARCH INSTITUTE CO., LTD
LANDTEC JAPAN INC.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF TRANSPORT, VIETNAM

SPECIAL ASSISTANCE FOR PROJECT IMPLEMENTATION (SAPI)
FOR ITS INTEGRATION PROJECT ON
NEW NATIONAL HIGHWAY NO.3 & NORTHERN AREA OF VIETNAM

BASIC DESIGN SPECIFICATIONS

FINAL REPORT IN AUGUST 2012

ORIENTAL CONSULTANTS CO., LTD
NEXCO EAST ENGINEERING CO., LTD
NIPPON KOEI CO., LTD
TRANSPORTATION RESEARCH INSTITUTE CO., LTD
LANDTEC JAPAN INC.

Introduction

The Basic Design Specifications of ITS Integration Project were prepared in this volume and that is fully comply with the Draft ITS General Specifications.

The Specifications defines required processing function, structure, performance, communication interface, and installation of equipment in order to establish compatibility of equipment components, which are organized by 24 volumes (including two volumes for infrastructure works) corresponding to the functional packages below:

(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) Radio-to-Vehicle Communication
(17) IC-Card Recording
(18) Toll Data Management
(19) OBU Management
(20) Axle Load Measurement
(21) Measurement Lane Monitoring
(22) Communication System
(23) Communication Ducts
(24) Base Structures

The drawings, specifications and reports developed in the Study are the results of basic design of the Project, and that of detailed design shall be prepared by the Contractor of the Project Implementation in compliance with the results of the basic design.

In the case regulations are updated, the specifications shall be updated in the detailed design by the Contractor of the Project Implementation in compliance with the latest regulations.

(1)
Voice Communication

1. General Outline

This functional package that allows to send an emergency call and a request for help to the Main Centers and road management offices at an incident occurrence using telephones installed at roadsides, rest areas and tunnel sections and by administrative telephones installed at the toll management offices. It also allows instantly sending instructions to the units concerned for clearing incidents and enforcing traffic regulations.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, and in the Main Centers, road management offices and toll management office of the expressway network for actualizing functional packages.

3. Relevant Regulations and Standards

- ITU-T G. 107: The E-Model, a computational model for use in transmission planning
- ITU-T G. 114: One-way transmission time
- ITU-T Y. 2012: Functional Requirements and Architecture of Next Generation Networks
- ITU-T Y. 1541: Network performance objectives for IP-based services
- IETF, RFC 3261 SIP: Session Initiation Protocol
- IETF, RFC 3550 RTP: A Transport Protocol for Real-Time Applications
- IETF, RFC 4566 SDP: Session Description Protocol
- ITU-T H.320: Standards for video conferencing
- ITU-T H323: Visual telephone systems and equipment for local area networks which provide a non-guaranteed quality of service
- ITU-T E161 Arrangements of digits, letters and symbols on telephones and other devices that can be used for gaining access to a telephone network
- BS 7430: Earthing
- BS 6651: Lightning Protection

4. Requirements

- System shall be capable of receiving notification of incident occurrence promptly from road user and to identify the user's location on the expressway.
- System shall be capable of receiving report of current traffic conditions on the expressways and of incident occurrence promptly from the operators in the toll office.
- System shall be capable of switching and connect the interactive voice and emergency

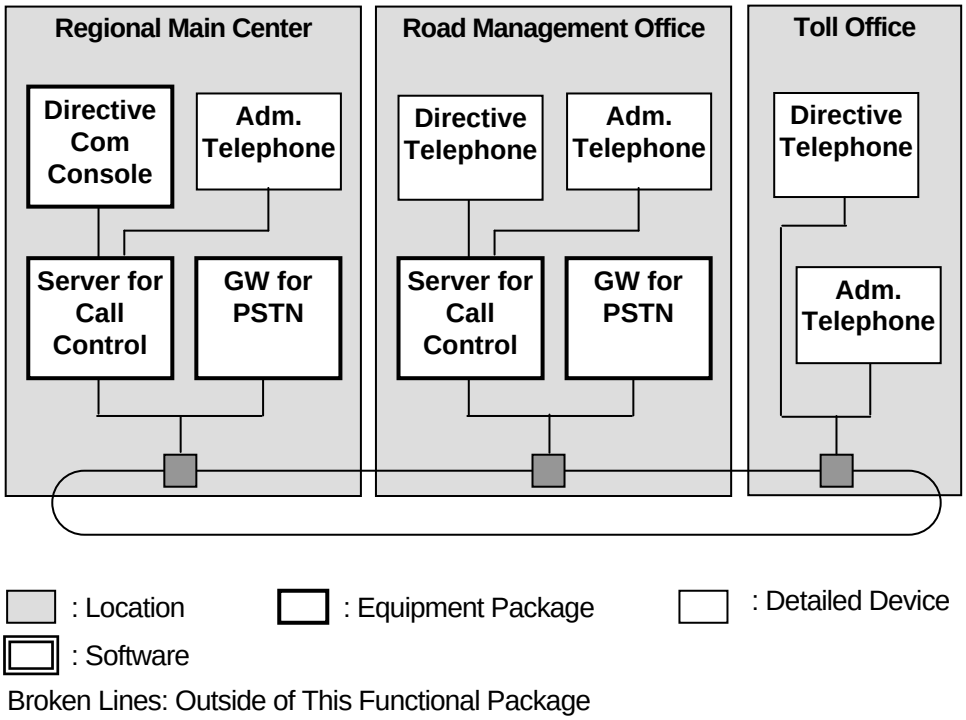
directives among Regional Main Center, Road Management Offices and toll offices.

- System shall be capable of sending directives to the units concerned simultaneously and with top-priority at any time for clearing incidents and enforcing traffic regulations.
- System shall be capable of receiving notification of incident occurrence generally within 20 minutes, and to send road operation vehicles to the incident site generally within 1 hour.
- System shall be capable of functioning 24 hours a day, 365 days a year by a redundant system with sufficient durability/reliability of equipment components.
- In case, part or whole of procurement and operation & maintenance related to the Telephone Exchange is to be outsourced to another organization such as telecommunications carrier or operator, it should be outsourced based on a mutually agreed document such as a contract that makes clear system demarcation points and responsibilities of each party.

5. System Architecture

System architecture for voice communication is shown below.

Figure 5.1 System Architecture for Voice Communication



6. Server for Call Control

6.1 Functions

- The Server for Call Control shall be capable of connecting directive communication from directive communication console 100% without any calling loss within ITS related communication network.
- The Server for Call Control shall be capable of controlling call for directive and administrative telephone within ITS related communication network.
- The Server for Call Control shall be capable of securing one to many communication.
- The Server for Call Control shall be capable of functioning as registrar which manages users, IP addresses and telephone numbers.
- The Server for Call Control shall be capable of functioning as proxy server which transmits connection request to another Server for Call Control when such request receives.
- The Server for Call Control shall be capable of functioning as redirect server which responds proper current addresses and requests to access with proper address again when calling side proxy server sends the improper connection requests.
- The Server for Call Control shall be capable of controlling Quality of Service on voice communication within ITS related communication network.
- The Server for Call Control shall be capable of controlling the gateway for PSTN.
- The Server for Call Control shall be complied with the international standard.
- The fault of the Server for Call Control shall be capable to be detected, and shall be notified to the operating staff. During emergency repairing time after detection of the system fault, continuous operation shall be secured with the redundant equipment component without any interruption.
- The Server for Call Control shall be those types whose usefulness have been confirmed by road operators, communication carriers or operators in the countries other than the originally manufactured country.

6.2 Structure

- The Server for Call Control shall have sufficient durability for 24hours a day, 365 days a year.
- The Server for Call Control shall have the structure which is possible to fix in the building in Regional Main Center and Road Management Offices.

- The structure of Server for Call Control shall be capable to replace the faulty parts simply and easily when it is detected.

- The structure of Server for Call Control shall be capable to implement the periodical checking and clean up activities.

6.3 Performance

- The performance of Server for Call Control shall be guaranteed so as to control required voice traffic in appropriate timing within the requirements stipulated in the concerned sections of this Document.

- The voice communication for directive communications and administrative telephone shall be complied with the conditions of Class 0 of ITU-T Recommendation Y.1541 within the communication network of ITS.

- The directive communication from Regional Main Center shall be connected without any connection loss. As for the Administrative Telephone, the connection loss shall be within 10% in the communication network of ITS.

- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year. During maintenance and repair period, the operation shall be continued with redundant components.

6.4 Human Machine Interface

- The Server for Call Control shall have human-machine interface so that the operator can input necessary commands into the system.

- The Server for Call Control shall be capable to detect the fault of the equipment components. When the fault is detected, the system shall be capable to notify it as alert such as buzzer or flashing light on the display to the O&M staff of NMS.

6.5 Communication Interface

- The communication interfaces of the Server for Call Control shall be complied with the international standard

- The communication interfaces of the Server for Call Control shall not be hindrance of voice communication.

6.6 Installation

- The Installation work shall include equipment component's unloading, customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.

- The Server for Call Control shall be installed in air conditioned room in Regional Main Center and Road Management Office.

- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.

- Software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely used in many countries.

- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.

- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

7 Gateway for PSTN

7.1 Functions

- The Gateway for PSTN shall be capable of originating call from administrative telephone in the ITS communication network to PSTN and capable of incoming call from PSTN to the administrative telephone in ITS communication network.

- The Gateway for PSTN shall be capable of converting voice packet which can be transmitted in IP network, into voice traffic in PSTN which is encoded into digital signal, and vice versa.

- The Gateway for PSTN shall be capable of resolve telephone number and IP address, and capable of connecting to the proper telephone terminal.

- The Gateway for PSTN shall be capable of converting call control signal in PSTN into call control signal in IP network, and vice versa, and it shall be capable of interconnecting between administrative telephone in ITS network and telephone in PSTN.

- The Gateway for PSTN shall be complied with the international standard.

- The fault of the Gateway for PSTN shall be capable to be detected, and shall be notified to the operating staff. During emergency repairing time after detection of the system fault, continuous operation shall be secured with the redundant equipment component without any interruption.

- The Gateway for PSTN shall be those types whose usefulness have been confirmed by road operators, communication carriers or operators in the countries other than the originally manufactured country.

7.2 Structure

- The Gateway for PSTN shall have sufficient durability for 24hours a day, 365 days a year.

- The Gateway for PSTN shall have the structure which is possible to fix in the building in Regional Main Center and Road Management Offices.

- The structure of Gateway for PSTN shall be capable to replace the faulty parts simply and easily when it is detected.

- The structure of Gateway for PSTN shall be capable to implement the periodical checking and clean up activities.

7.3 Performance

- The performance of Gateway for PSTN shall be guaranteed so as to control required voice traffic in appropriate timing within the requirements stipulated in the concerned sections of this Document.

- The voice communication for administrative telephone shall be complied with the conditions of Class 0 of ITU-T Recommendation Y.1541 within the communication network of ITS.

- As for the Administrative Telephone, the connection loss shall be within 10% in the communication network of ITS.

- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year. During maintenance and repair period, the operation shall be continued with redundant components.

7.4 Human Machine Interface

- The Gateway for PSTN shall have human-machine interface so that the operator can input necessary commands into the system.

- The Gateway for PSTN shall be capable to detect the fault of the equipment components. When the fault is detected, the system shall be capable to notify it as alert such as buzzer or flashing light on the display to the O&M staff of NMS.

7.5 Communication Interface

- The communication interfaces of the Gateway for PSTN shall be complied with the international standard

- The communication interfaces of the Gateway for PSTN shall not be hindrance of voice communication.

7.6 Installation

- The Installation work shall include equipment component's unloading, customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.

- The Gateway for PSTN shall be installed in air conditioned room in Regional Main Center and Road Management Office.

- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.

- Software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely used in many countries.

- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.

- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

8. Directive Communication Console

8.1 Functions

- The directives from the Regional Main Center shall be switched and connected without any connection loss in accordance with the options selected by operator through the Directive Communication Console.
- There are several types of directives from the Regional Main Center: directive to all, directive to concerned Road Management Office and directive to the specific region(s), and directive to a specific offices including Toll Office.. The directive communication console shall recognize these different types of directives simply and clearly.
- Faults of directive communication console equipment components shall be capable to be detected and notified to the operating staff. During emergency repairing time after detection of the system fault, continuous operation shall be secured with the redundant equipment component with minimum interruption.
- Directive communication console equipment components shall have been accepted by road operators, communication carriers or operators in the countries other than the original manufacturing country.

8.2 Structure

- The directive communication console equipment component shall have sufficient durability for operating 24 hours a day, 365 days a year.
- The directive communication console equipment component shall be capable to be installed in the main center building.
- Faulty parts of directive communication equipment components shall be replaceable simply and easily when fault is detected.
- The directive communication equipment components shall be capable of implementing periodic checking and clean up activities.

8.3 Performance

- The Console shall be capable of identifying directive destination clearly.
- The console shall be capable of indicating directive destination and acknowledgements from the recipients of directives.
- The speech quality of the voice communications shall comply with or be equivalent to the quality of fixed line telecommunications carrier and have at least the following performance:

  Directive Communication:
  From Directive Console to the terminal equipment component to receive the directive call: within 18dB
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year. During maintenance and repair period, operation shall be continued with redundant components.

8.4 Human Machine Interfaces

- The directive communication console at Regional Main Center shall have human-machine Interface so that the Traffic Information/Control Operator can transmit directive, receive acknowledgements from the receiver of directive and make voice communications.
- The directive communication console shall be capable to detect the fault of the equipment components. When the fault is detected, the system shall be capable to notify it as alert such as buzzer or flashing light on the display to the O&M staff of NMS.

8.5 Communication Interfaces

- All of the interfaces of directive communication console equipment components to be installed in main center shall be compatible with other connecting communication equipment components and shall not be a hindrance to communication.

8.6 Installation

- The Installation work shall include equipment component's unloading, customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Directive Communication Console shall be installed in Operating Room for Traffic

Information/Control in Regional Main Center.

- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- Software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely used in many countries.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the directive communication equipment components bonding with the grounding of the lightning protection system and other grounding facilities installed within a short distance.
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

9. Directive Telephone

9.1 Functions

- The directive telephone equipment component which receives directive from Regional Main Center shall be equipped to issue notification alert to the operating staff on receiving a directive with buzzer or flashing light.
- The directive telephone equipment component shall be capable to respond as acknowledgement of directive with button or similar mechanism when the staff receives the directive.
- The directive telephone equipment component shall have been accepted by road operators, communication carriers or operators in the countries other than the original manufacturing country.

9.2 Structure

- The directive telephone equipment component shall have sufficient durability for operating 24 hours a day, 365 days a year.
- Faulty parts of directive telephone equipment component shall be replaceable simply and easily when fault is detected.

9.3 Performance

- The directive telephone equipment component shall be operated simply.
- The speech quality of the voice communications shall comply with or be equivalent to the quality of fixed line telecommunications carrier and have at least the following performance:

  Directive Communication:
  From Directive Console to the terminal equipment component to receive the directive call: within 18dB
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

9.4 Human Machine Interfaces

- The directive telephone equipment component which receives directive from the Regional Main Center shall have human-machine interface so that the receiver of the directive can recognize receipt of directive with buzzer or flashing light.
- The directive telephone equipment component shall have human-machine interface so that the receiver of the directive can send acknowledgement of directive with button or similar mechanism.

9.5 Communication Interfaces

- All of the interfaces of directive telephone terminal shall be compatible to other connecting communication equipment components and shall not be a hindrance to communication.

9.6 Installation

- The Installation work shall include equipment component's unloading, customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Directive Telephone shall be installed in necessary rooms in Regional Main Center, Road Management Offices, and Toll Offices.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment components shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing

protection shall be applied to the equipment component bonding with the grounding of the lightning protection system and other grounding facilities installed within a short distance.

- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

10. Administrative Telephone

10.1 Functions

- The administrative telephone shall be capable of connecting Public Switched Telephone Network (PSTN) in addition to the connection among Main Center, Road Management Office (RMO), Toll Management Office (TMO) and Rest Area.
- The administrative telephone equipment component shall have been accepted by road operators, communication carriers or operators in the countries other than the original manufacturing country.

10.2 Structure

- The administrative telephone equipment component shall have sufficient durability for operating 24 hours a day, 365 days a year.

10.3 Performance

- The speech quality of the voice communications shall comply with or be equivalent to the quality of fixed line telecommunications carrier and have at lest the following performance:

  Administrative Voice Communication:
  From one administrative terminal equipment component to another administrative terminal equipment component: within 26dB

- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

10.4 Human Machine Interfaces

- The key arrangement of administrative telephone equipment components shall be as described by ITU-T Recommendation E. 161.

10.5 Communication Interfaces

- All of the interfaces of administrative telephone equipment components shall be compatible to connect to other communication equipment components and shall not be a hindrance to communication.

(1) Voice Communication

10.6 Installation

- The Installation work shall include equipment component's unloading, customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over if the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The administrative Telephone shall be installed in necessary rooms in Regional Main Center, Road Management Offices, and Toll Offices.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment components shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the administrative telephone equipment components bonding with the grounding of the lightning protection system and other grounding facilities installed within a short distance.
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

11. Ambient Conditions

- The equipment component shall be protected against interferences of other electronic devices and electromagnetic noises at the Project site.
- The Server for Call Control, GW for PSTN and Directive Communication Console shall be housed in an air conditioned clean room.
- Equipment components to be installed outside shall be capable to operate and withstand under the ambient conditions such as natural conditions, meteorological conditions, electromagnetic noise, and other environmental conditions of the Project site in Vietnam. The Contractor shall check ambient conditions of the Project site and proper protection shall be designed for individual equipment components.
- The spare parts of the voice communication related equipment components shall be housed in the air conditioned clean room to maintain their performance. The accommodation conditions are subject to individual equipment requirements for storage environment.

12. Power Supply

- The main power supply shall be AC220 volts, single phase and 50 Hz frequency.
- The electric power supply for voice communication related equipment component shall be equipped with redundant power supply for securing operation for 24 hours a day, 365 days a year.
- A backup electric power supply for equipment components related to directive communications shall be capable to operate at least 24 hours during commercial power failure.

13. Maintainability

- The equipment components shall be maintainable easily and simply.
- The voice communication related equipment components shall be capable to identify the faulty parts easily when fault is detected, and the replacement of the parts shall be simple.
- The Manufacturer shall guarantee the availability of spare parts of the supplied equipment components at least five (5) years after the equipment components are handed over to the road management authority .
- The manufacturer of the voice communication related equipment components shall submit the necessary documents for the operation and maintenance such as manuals and check list, and provide necessary training to operation and maintenance staffs of the related equipment components.
- The manufacturer/supplier of the voice communication related equipment components shall make a contract with the road management authority for technical support related to the delivered equipment components during the operation and maintenance period and the manufacturer/supplier shall provide the necessary services based on that contract.

14. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project, and final inspection division before shipping.
- The manufacturer shall be required to submit a copy of the ISO9001 authentication document specified above attached to the tender or prequalification proposal.

15. Testing/Inspection

1) General

The Test and Inspection for the voice communication related equipment components shall be implemented in accordance with the following conditions:

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test between switching system and terminal equipment components.

(3) There are also three types of inspections similar to the tests. The connection inspections are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall at least include inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval.

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The equipment component unit test procedure at site after installation shall be submitted to the road management authority and the consultant for approval.

(4) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(5) If necessary, the road management authority and/or the consultant may request to inspect the equipment component unit test at site.

(6) The test and inspection procedure of the connection test shall be submitted to the road management authority and the consultant.

(7) After approval of the connection test procedure, the contractor's own connection test shall be implemented and the test result shall be submitted to the road management authority and the consultant.

(8) The inspection for the system connection shall be implemented witnessed by the road management authority and the consultant.

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in the appropriate timing before commencement of the tests and inspections, in hard copy including the following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, checklist which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(2)
CCTV Monitoring

1. General Outline

This functional package allows the road operators to capture the current situation of traffic accidents, broken-down vehicles, left obstacles, driving in the reverse direction, vandalism, natural disaster and traffic conditions on the expressways and to monitor the captured video image at the Main Centres and road management offices by using cameras installed at road sections where traffic can be stuck easily by incidents and at long tunnel sections.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, and in the Main Centres, road management offices of the expressway network for activating functional packages.

3. Relevant Regulations and Standards

1) International Standards

- ISO 14813-1:2007 Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- IEC 60529: (Ingress Protection Rating)
- ISO/IEC 14496-2: (MPEG4-Part 2)
- ITU-T H. 264 and ISO/IEC 14496-10: (MPEG4-Part 10)
- IEEE 802.3
- IEEE 802.3af: Power over Ethernet
- IEEE 802.3at: 10BASE-T/100BASE-TX PoE Plus
- ISO/IEC 14496: (Coding of audio-visual objects)

2) National Standards

- TCVN 4054:2005 , Motorway - Requirements KEH
- TCVN 5729
- TCVN 2737:1995

4. Requirements

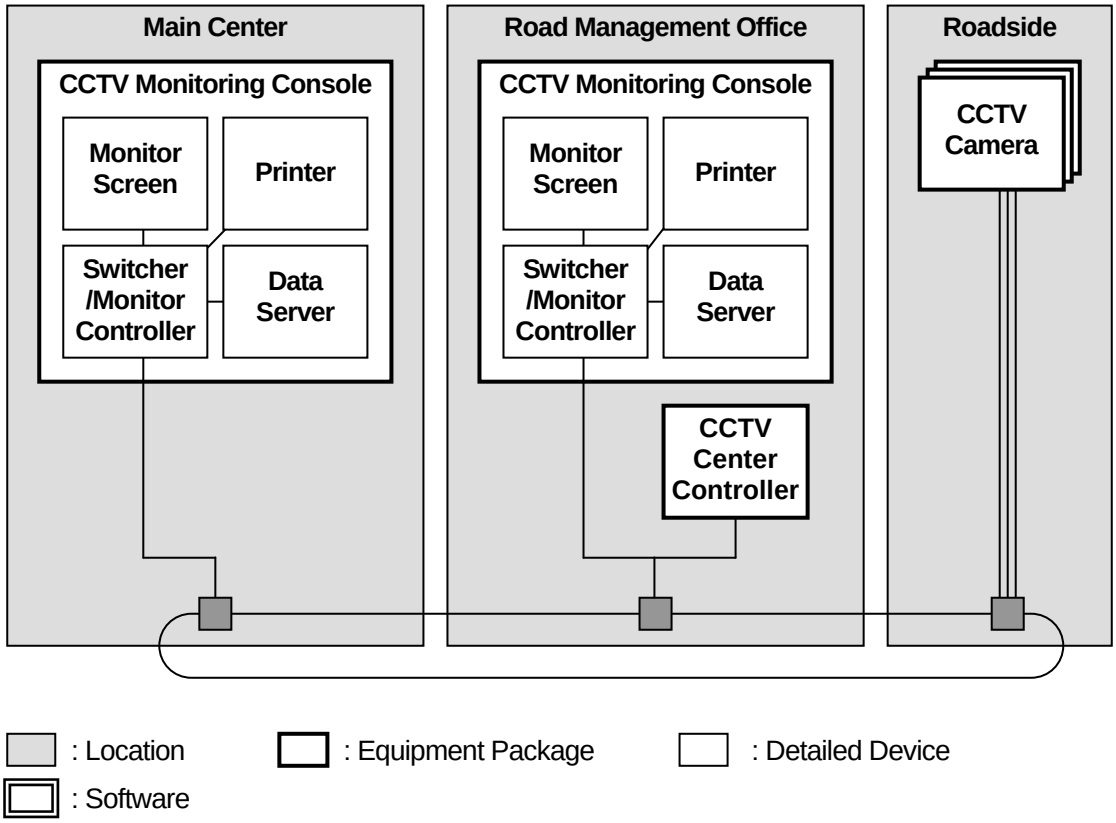
- System shall be capable of recognizing incident occurrences on the road and their type, such as traffic accidents, breakdown vehicles, left obstacles, driving in the reverse direction, vandalism and natural disaster, by remote monitoring at the Main Center and road management office.

- System shall be capable of recognizing the severity of incidents through identifying types of vehicles involved (such as trucks, buses and sedans) by appearance.
- System shall be capable of identifying the place of incident occurrence from the Main Center and road management office.
- System shall be capable of installing roadside equipment adequately at bottleneck spots on the road where traffic can be stuck easily by incident and at tunnel sections.
- System shall be capable of controlling roadside equipment remotely from the Main Center in realtime and from road management office at a occurrence of incident.
- System shall be capable of minimizing the required number of monitoring devices.
- System shall be capable of minimizing load caused by data transmission including video image on the communication system.
- System shall be capable of storing the needed video images.
- System shall be capable of indicating and printing out the needed results.
- System shall be capable of saving implementation cost by utilizing internet technologies.
- System shall be capable of securing sufficient durability and reliability of equipment components in ambient conditions at roadside.

5. System Architecture

System architecture for CCTV monitoring is shown below.

Figure 5.1 System Architecture for CCTV Monitoring



6. CCTV Camera

6.1 Functions

- To monitor vehicles on the expressway and identify types of the vehicles by their appearance.
- To make images of road traffic by using black/white or colour image continuously 24 hours a day, 365 days a year excluding time for regular maintenance.
- To synchronize its clock to the clock of “CCTV Center Controller” at the start-up to allow picking out required images from the accumulated images from all cameras.
- CCTV shall be capable of correcting brightness of captured image automatically. (This is called the iris function.)
- CCTV shall have auto-focus function to be controlled from “CCTV Monitor Console”
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with the measures against water, rust, dust, salt water in case equipment components are installed outdoors.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow maintenance works from the sides and/or back, but not from lane direction, in order to minimize the influence to traffic activities.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with the measures against interference from other electronic devices.
- CCTV camera shall be protected against dust and water ingress if it will be installed outdoors in road typical section in accordance with IP66 of the international standards IEC 60529 or equivalent.
- The system shall be capable of fully meeting the requirements even under night conditions.
- The Fixed camera shall be capable of complying with CS–mount standards.

6.3 Performance

There are two types of CCTV camera: Panning/Tilting/Zooming (PTZ) Type and Fixed Type.

- Panning/Tilting/Zooming (PTZ) Type camera: The camera shall have panning/tilting and zooming functions
- Fixed Type camera: The camera does not have panning/tilting functions, and may have zooming function.

The general requirement for both types are as follow:

- The system shall be capable of controlling the lens aperture in tune with the brightness of the subject and of outputting the best suited video image.
- The system shall have video image output interface to adjust angle of view of camera and receiving control signal interface to check camera operations at setup at installation site.
- The equipment components shall be capable of taking images road traffic by at least Black/White image for continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The equipment component shall be supplied with Device Driver for controlling camera functions. ONVIF compliance is required for CCTV cameras.

Detailed specification of PTZ Type camera:

- Size of image sensor must be greater than 1/4".
- Minimum focal length of lens must be between 3.0mm and 5.0mm.
- The camera resolution must be greater than 1 mega pixel or 1280x720.
- The minimum illumination in day mode and night mode should be lower than 1.0 lx and 0.3 lx respectively, without slow shutter function.
- The camera must be capable of encoding in H.264, MPEG4-Part2 and Motion JPEG.
- The camera shall be protected in accordance with IP66, ISO/IEC 60529.
- The camera must be able of panning at least 350 degrees and tilt 100 degrees.
- The camera must be capable of using x10 optical zooming.
- The frame rate should be greater than 25 fps
- The camera must consumed power less than 100W
- The camera can operate at -30 to 50 degrees with humidity range from 20 to 90% (non-condensing).
- The maximum surveillance range should be greater than 1000m by using PTZ function in ideal condition.
- The device’s weight should be less than 5.0 kg.

Detailed specification of Fixed Type camera:

- Size of image sensor must be greater than 1/4".
- Minimum focal length of lens must be between 3.0mm and 5.0mm, and may be changed based on CS mount lens.
- The camera resolution must be greater than 1 mega pixel or 1280x720.
- The minimum illumination in day mode and night mode should be lower than 1.0 lx and 0.1 lx respectively, without slow shutter function.
- The camera must be capable of encoding in H.264, MPEG4-Part2 and Motion JPEG.
- The camera shall be protected in accordance with IP66, ISO/IEC 60529.
- The frame rate should be greater than 25 fps.
- The camera must consumed power less than 50W.
- The camera can operate at -30 to 50 degrees with humidity range from 20 to 90% (non-condensing).
- The maximum surveillance range should be greater than 150m without PTZ functions.
- The device's weight should be less than 4.0 kg.

6.4 Human Machine Interfaces

- CCTV camera shall have the function to output test image to personal computers at site so that installation staff may adjust the direction of the camera.
- The system shall have video image output interface to adjust angle of view of camera and receiving control signal interface to check camera operation at setup at installation site.

6.5 Communication Interfaces

- The system shall be capable of controlling the signal for images transmitted over TCP/IP.
- The equipment components shall be capable of having following communication interfaces in order to ensure that equipment components to be controllable with CCTV, and accessible to CCTV video images from another equipment / console.
  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Transmission data format
  - Timing chart and other details of the standard interfaces
- PTZ Type camera: The camera may use 10BASE-T/100BASE-TX PoE Plus interfaces based on IEEE 802.3at.

- Fixed Type camera: The camera should use 10BASE-T/100BASE-TX PoE interfaces.
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

6.6 Installation

CCTV camera installation has the following general requirement:

- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- CCTV camera with panning, tilting and zooming functions shall be installed at intervals of 2 km or less along through lanes so as to monitor situations such as incidents, broken vehicles, traffic congestions, and bad weather through day and night
- One or more fixed CCTV camera shall be installed on the ramp so as to monitor situations such as incidents, broken vehicles, traffic congestions, and bad weather through day and night.
- CCTV cameras shall be installed so as to get images of the road within one kilometer range without influence of obstacles such as plane curve, longitudinal slope, roadside cutting slope, overbridges, buildings, trees, lighting poles, traffic signs, and VMS.
- CCTV cameras shall be installed so that direction of camera may not be rotated by strong wind.
- CCTV camera shall be installed so that images may not swing by strong wind.
- CCTV camera shall be capable of being vertically and horizontally adjusted during installation at roadside.
- Horizontal and vertical angle of CCTV camera shall be capable of being adjusted and fixed appropriately at the installation site.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.
- In case of more than one camera are attached on the same pole, each camera shall be attached with at least 1m height interval.
- The angle of view of a camera shall be adjusted for monitoring the road continuously in consideration of the field of investigation.
- In case the equipments to be located at outdoor, the screw for attachment should be antitheft type.

CCTV camera installation is divided into three categories:

- Installation of PTZ type camera on through lanes.
- Installation of PTZ type camera for monitoring junction/interchange including toll gate.
- Installation of Fixed type camera on ramp.

Installation of PTZ type camera on through lanes:

- PTZ type cameras should be installed along the expressway at least every 2km.
- Two PTZ type cameras shall be installed:
  - One PTZ type camera for monitoring inbound lane.
  - One PTZ type camera for monitoring outbound lane.
- PTZ type camera installation should be adjusted based on actual conditions:
  - PTZ type camera need to be installed in case of disrupting vision obstacles such as flyover bridge, longitudinal gradient of road, roadside cutting slope, overbridges, buildings, trees, lighting poles, traffic signs, VMS, alignment of road, tollgate, etc.
  - PTZ type camera should be installed to adapt an interchange's requirement if necessary.
  - In ideal condition, PTZ type camera should be capable of monitoring the road continuosly by using PTZ functions.
- PTZ type camera should be installed 6-7m above ground level in accordance with the limit vertical clearance of road in accordance with TCVN 4054:2005 and TCVN 5729.

Installation of PTZ type camera for monitoring junction/interchange including toll gate:

- PTZ type cameras should be installed according to junction and interchange type. Each type require different PTZ camera location to monitor the whole area.
- In ideal condition, PTZ type camera should be able to monitor the whole junction/ interchange, including toll gate.
- PTZ type camera need to be installed in case of disrupting vision obstacles such as flyover bridge, longitudinal gradient of road, roadside cutting slope, overbridges, buildings, trees, lighting poles, traffic signs, VMS, alignment of road, tollgate, etc.
- PTZ type camera should be installed 6-7m above ground level in accordance with the vertical clearance of road in accordance with TCVN 4054:2005 and TCVN 5729.
- In ideal condition, PTZ type camera should be capable of monitoring the area continuously by using PTZ functions.

Installation of Fixed type camera on ramp:

- A Fixed type camera should be installed to monitor each ramp of the junction or

interchange.

- Fixed type cameras shall be installed attached on roadside around the diverging/merging point of ramp with the maximum surveillance area possible.
- Fixed type camera should be installed 7-8m above ground level in accordance with the limit construction clearance in accordance with TCVN 4054:2005 and TCVN 5729.
- Fixed type camera need to be installed in case of disrupting vision obstacles such as flyover bridge, longitudinal gradient of road, roadside cutting slope, overbridges, buildings, trees, lighting poles, traffic signs, VMS, alignment of road, tollgate, etc.

7. Central CCTV Controller

7.1 Functions

- The central CCTV controller shall be capable of controlling CCTV cameras functions such as zooming, panning and tilting.
- The CCTV camera shall be capable of being controlled from “Regional Main Center” or “Road Management Office” depending on the given priority.
- The system shall be capable of synchronizing its clock to the clock of “CCTV Center Controller” at Regional Main Center at start-up.
- The central CCTV controller can record simultaneously and give remote access of live video streams from CCTV cameras.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with the measures against interference from other electronic devices

7.3 Performance

- The central CCTV controller complies with H.264, MPEG-4 Part 2, and Motion JPEG video compression.
- The central CCTV controller shall operate with less than 6Mbps bit rate and over 25 fps

frame rate.

- The central CCTV controller may have recording unit with: At least 1 mega pixel resolution; More than 1 fps frame rate. This unit should be capable of recording continuously two day more.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The equipment components shall comply to ONVIF conformation.

7.4 Human Machine Interfaces

- Operators shall use CCTV monitoring console for setting the functions of Central CCTV Controller.
- The system shall be equipped with functions of panning, tilting, and zooming of cameras using keyboards, joysticks and track balls by operators at the Regional Main Center and Road Maintenance Office who are monitoring the images taken by CCTV cameras.
- The system shall be equipped with the functions so that operator sitting at the console 5m away from the main screen at Regional Main Center may confirm such situations as incidents, broken vehicles, traffic congestions, and bad weathers on the expressways through day and night by indicating images taken by CCTV cameras on the main screen of Regional Main Center.

7.5 Communication Interfaces

- The system shall be capable of controlling the signal for images transmitted over TCP/IP.
- The central CCTV controller can function with Ethernet input/output signal in accordance to IEEE 802.3.
- The central CCTV controller must have 100BASE and 1GBASE Ethernet interfaces.
- The central CCTV controller must have RJ-45 connector.
- The central CCTV controller shall be capable of working with Ethernet protocols such as: IP, UDP, RTP, multicast.
- The following information shall be disclosed for communication interfaces for the equipment components to control CCTV and accessible to CCTV video images from another equipment / console.

  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Transmission data format
  - Timing chart and other details of the standard interfaces

- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

7.6 Installation

- Software shall be capable of being installed on an operating system such as Microsoft Windows or Linux which is widely used in many countries.
- The equipment of components shall be installed at each Road Management Office.
- The total number of equipments estimated to install depends on the number of cameras and the number of interfaces on an equipment.

8. CCTV Monitoring Console

8.1 Functions

- The equipment components shall be capable of monitoring vehicles on the expressways and identifying the appearance of vehicles.
- The functions of the CCTV cameras shall be controlled remotely by using such equipments as joystick, keyboard, trackball in the Regional Main Center. The camera control shall be conducted using IP address corresponding to the camera identification number.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- Chassis of equipment shall be capable of dissipating temperature arising from inside equipment.
- The equipment components shall be protected with the measures against interference from other electronic devices.

8.3 Performance

- The system shall be capable of controlling the zooming, the tilting and the panning functions of cameras.
- The system shall be capable of displaying the selected camera image on the designated monitor screen.
- Recommended size of monitor screen shall be (approx.) 20 inches or over.
- All camera images shall be capable of being displayed on Monitor Screen for the operating staff to monitor the traffic conditions.
- However, some issues are envisioned as follows:
  - The room space may not be enough to locate all necessary Monitor Screens.
  - The number of operators is not enough for monitoring all CCTV images displayed on Monitor Screens.

  Therefore, number of monitors should be controlled as follows:
  - Multi images shall be separately displayed on the same Monitor Screen.

- Images of different cameras shall be displayed on the same Monitor Screen in defined rotating interval.

- The system shall be capable of displaying retrieve results on the monitor.
- The system shall be capable of capturing CCTV images as still pictures.
- The system shall be capable of monitoring road traffic by at least Black/White images continuously 24 hours a day for 365 days, except for maintenance and repair period.

8.4 Human Machine Interfaces

- The equipment components shall have human-machine interface such as keyboard, joystick, or track ball, so that the Traffic Information Operator can operate the camera system.
- The system shall be capable of printing captured still pictures by using A4 printer.
- The system shall be capable of printing displayed images by using A4 printer.
- The monitor in the console shall be greater than 20 inches so that operators at Regional Main Center and Road Maintenance Office may confirm incidents, broken vehicles, traffic congestions, and bad weathers on the expressways through day and night by indicating images taken by CCTV cameras on the main screen.

8.5 Communication Interfaces

- The system shall be capable of controlling the signal for images transmitted over TCP/IP.
- The equipment components shall have the following communication interfaces and information in order to ensure that equipment components are controllable by CCTV, and accessible to CCTV video images from another equipment / console.

  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Transmission data format
  - Timing chart and other details of the standard interfaces

- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

8.6 Installation

- Software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely used in many countries.

- The equipment of components shall be installed in the Regional Main Center or Road Management Office.
- In case the equipments to be located at outdoor, the screw for attachment should be antitheft type.

9. Ambient Conditions

- The equipment components shall be installed in the offices and protected by the measures against interferences of other electronic devices.
- The equipment component shall be capable of normally operating under the following ambient conditions.

For Regional Main Center, Toll Management Center, and Toll Office
Temperature: 25 +/- 3 degree C in average
Relative humidity: between 20 and 80 % in average
For outside
Temperature: between - 0 and +50 degree C
Relative humidity: below 95 %

10. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- System shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for at least 30 minutes.

11. Maintainability

- The system shall be capable of being maintained easily and simply.
- The system shall be capable of identifying faulty parts easily in case equipment fault is detected, and the replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.
- The manufacturer of the equipment components shall make a contract on technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer shall provide the necessary services based on the contract.

12. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit a copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

13. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions;

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation:

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(3)
Event Detection (by Image)

1. General Outline

This functional package allows the road operators to automatically recognize occurrence of traffic accidents, broken-down vehicles and left obstacles on the expressways and to send notification to the Main Centers and road management offices by analyzing video images from cameras installed at bottleneck spots where traffic can be easily stuck and at long tunnel sections.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, for activating functional packages.

3. Relevant Regulations and Standards

1) International Standards

- ISO 14813-1:2007 Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- ISO/IEC 13818-1:2000 Information Technology – Generic coding of moving pictures and associated audio information: Systems
- ISO/IEC 13818-2:2000 Information Technology – Generic coding of moving pictures and associated audio information: Video (ITU-T Recommendation H.262)
- ISO/IEC 13818-3:2000 Information Technology – Generic coding of moving pictures and associated audio information: Part 3: Audio
- ISO/IEC 14496-2: (MPEG4-Part 2)
- ITU-T H. 264 and ISO/IEC 14496-10: (MPEG4-Part 10)
- IEEE 802.3
- IEEE 802.3af: Power over Ethernet
- ISO/IEC 14496: (Coding of audio-visual objects)

2) National Standards

- TCVN4054:2005 , Motorway - Requirements KEH
- TCVN5729

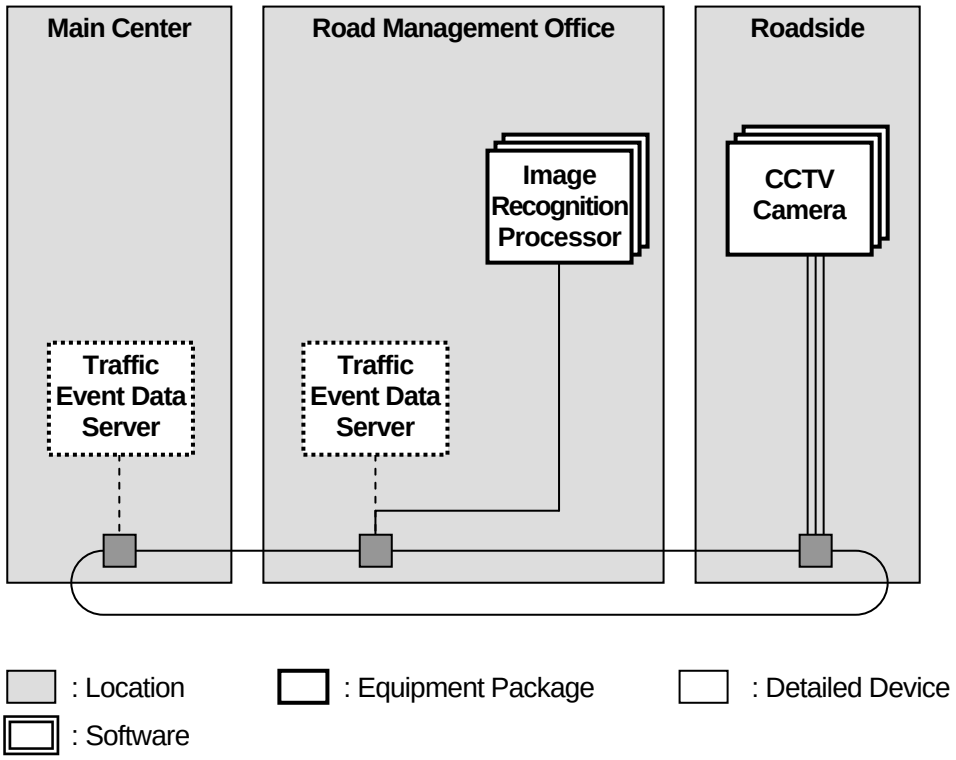
4. Requirements

- System shall be capable of automatically and promptly detecting incident occurrences and their types, such as traffic accidents, breakdown vehicles, left obstacles, driving in the reverse direction, vandalism and natural disaster, by analyzing video image captured at roadside.
- System shall be capable of measuring number of vehicles and vehicle speed at a specific point on the road.
- System shall be capable of notifying the detected results automatically and promptly to the Main Center road and management office.
- System shall be capable of monitoring original video image remotely at the Main Center and road management office.
- System shall be capable of identifying the time and place of incident occurrence at the Main Center and road management office.
- System shall be capable of allowing installing roadside equipment adequately at bottleneck spots on the road where traffic can be stuck easily by incident and at tunnel sections.
- System shall be capable of minimizing load caused by data transmission including video image on the communication system.
- System shall be capable of allowing securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

5. System Architecture

System architecture for event detection is shown below.

Figure 5.1 System Architecture for Event Detection



6. CCTV Camera

6.1 Functions

- To monitor vehicles on the expressway and identifying types of the vehicles by their appearance.
- To take an image of vehicle license number plate upon control signal.
- To correct brightness of captured image automatically. (That is called as the function of iris.)
- To have auto-focus function to be controlled by using “CCTV Monitor Console”.
- To operate continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- To synchronize its clock to the clock of “Traffic Event Data Server” at start-up.
- ONVIF compliance is required for CCTV cameras.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

6.2 Structure

- Countermeasures against dust and rain shall be taken on the CCTV camera installed outside (except tunnels) according to the international standard IEC 60529 defined by IP66 or equivalent.
- The camera shall be capable of complying with CS–mount standard.
- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoors.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow performing maintenance works from the sides and/or back, but not from lane direction, in order to minimize the influence to traffic activities.
- The chassis of equipment shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices

6.3 Performance

- The equipment components shall be capable of taking images road traffic by at least Black/White image for continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- Size of image sensor must be greater than 1/4".
- Minimum focal length of lens must be greater than 5.0mm, and may be changed based on CS mount lens.
- The camera resolution must be greater than 1 mega pixel or 1280x720.
- The minimum illumination in day mode and night mode should be lower than 1.0 lx and 0.1 lx respectively, without slow shutter function.
- The camera must be capable of encoding in H.264, MPEG4-Part2 and Motion JPEG.
- The camera shall be protected in accordance with IP66, ISO/IEC 60529.
- The frame rate should be greater than 25 fps.
- The camera must consumed power less than 50W.
- The camera can operate at -30 to 50 degrees with humidity range from 20 to 90% (non-condensing).
- The maximum surveillance range should be greater than 150m without panning, tilting, and zooming functions.
- The device's weight should be less than 4.0 kg.
- The system shall be capable of fully meeting the requirements even under night conditions.

6.4 Human Machine Interfaces

- CCTV camera shall have the function to output test image to personal computers at site so that installation staff may adjust the direction of the camera.
- The system shall have video image output interface to adjust angle of view of camera and receiving control signal interface to check camera operations at setup at installation site.

6.5 Communication Interface

- The system shall provide control signal for image transmitting over TCP/IP.
- The equipment components shall have the following communication interfaces in order to ensure that equipment components are CCTV controllable , and CCTV video images are accessible from other equipment / consoles.

  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices

- Transmission data format
- Timing chart and other details of the standard interfaces

- The camera should use 10BASE-T/100BASE-TX interfaces.
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

6.6 Installation

- The equipment components shall be appropriately installed at locations where incident possibility is high: Junctions and Interchanges.
- A Fixed type camera should be installed to monitor each ramp of the junction or interchange.
- Fixed type cameras shall be installed attached on the median around the diverging point with the maximum surveillance area to shoot the image of vehicles.
- Fixed type camera should be installed 7-8 m above ground level in accordance with the limit construction clearance in accordance with TCVN 4054:2005
- Horizontal and vertical angle of CCTV camera shall be adjustable, and shall be fixed appropriately.
- CCTV camera shall be capable of being vertically and horizontally adjusted during installation at roadside.
- Equipment components shall have adequate robustness against the wind of 60 m/s speed or equivalent.
- The equipment component shall be supplied with Device Driver for controlling camera functions. ONVIF compliance is required for CCTV cameras.
- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- In case the equipments to be located at outdoor, the screw for attachment should be antitheft type.

7. Image Recognition Processor

7.1 Functions

- The equipment components shall be capable for recognition of the following occurrences on the expressway automatically from CCTV images. The results of recognition are to be transmitted to “Traffic Event Data Server”.

  <Incident Occurrence>
  - Stopped Vehicle
  - Indirection Vehicle
  - Speed drop

  <Traffic Data>
  - Number of Vehicles
  - Average Vehicle Speed
  - Occupancy
  - Traffic flow speed

- The equipment components shall be capable of synchronizing its clock to the clock of “CCTV Monitoring Console” at start-up.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The Image Recognition Processor shall have sufficient durability for 24hours a day, 365 days a year.
- The Image Recognition Processor shall have the structure which is possible to fix in the building in Road Management Office.
- The structure of Image Recognition Processor shall be capable to replace the faulty parts simply and easily when it is detected.

- The structure of Image Recognition Processor shall be capable to implement the periodical checking and clean-up activities.

7.3 Performance

- Distance of Recognition: equivalent to Installation height of CCTV x 10 times or over
- The equipment components shall be capable of transmitting the recognized Incident Occurrence and Traffic Data to “Traffic Event Data Server”.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The equipment components shall be capable of discretionarily setting the unit time of volume, average speed, occupancy and traffic flow speed.
- The equipment components shall be capable of digitising and outputting the reliability of recognition result which represents the accuracy of the number plate recognition results. (in case the recognition for incident occurrence)
- In case of recognition results below the threshold reliability level, the equipment components shall be capable of not transmitting the result of event detection to “Traffic Event Data Server”.
- The equipment components shall be capable of automatically recording the CCTV video images during 2 minutes at the time of incident occurrence. Then the recorded images are to be transmitted to “Traffic Event Data Server”.
- All results of event detection shall be logged, including not transmitted results.
- The system shall have video image output interface to adjust angle of view of camera and control signal receiving interface to check camera operations for setup at installation site.
- The system shall be capable of controlling the lens aperture in tune with the brightness of the subject and of outputting the best suited video image.

7.4 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The system shall have the following interfaces between transmission devices:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be capable of

being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

- The functions of the CCTV cameras shall be controlled remotely by using a keypad at the console in the Main Center. The camera control shall be conducted using IP address corresponding to the camera identification number.

7.5 Installation

- Image recognition can be installed into Fixed type camera with specification mentioned at Article 6.
- The equipment of components shall be installed at each Road Management Office.
- The total number of equipments estimated to install depends on the number of cameras for using Event Detection.
- The software shall be capable of being installed on an operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

8. Ambient Conditions

- The equipment components shall be installed in the offices, toll booth, outside and shall be protected with measures against interference of other electronic devices.
- The equipment components shall be capable of operating normally under the following ambient conditions:

For Main Center, Toll Management Center, and Toll Office
Temperature: 25 +/- 3 degree C in average
Relative humidity: between 20 and 80 % in average
For outside
Temperature: between - 0 and +50 degree C
Relative humidity: below 95 %

9. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 30 minutes.

10. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The system shall be capable of identifying the faulty parts easily in case equipment fault is detected, and the replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.
- The manufacturer of the equipment components shall make a contract on technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer shall provide the necessary services based on the contract.

11. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit a copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

12. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions:

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, checklist which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(4)
Vehicle Detection

1. General Outline

This functional package allows the road operators to measure actual traffic volume, heavy vehicle ratio and vehicle velocity on the expressways for developing road operation/ improvement plans by using vehicle detectors installed at important points on the throughway and the tollgates.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, for activating functional packages.

3. Relevant Regulations and Standards

- ISO 14813-1:2007 Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- IEC 60529: Degrees of Protection provided by Enclosure (IP Code)

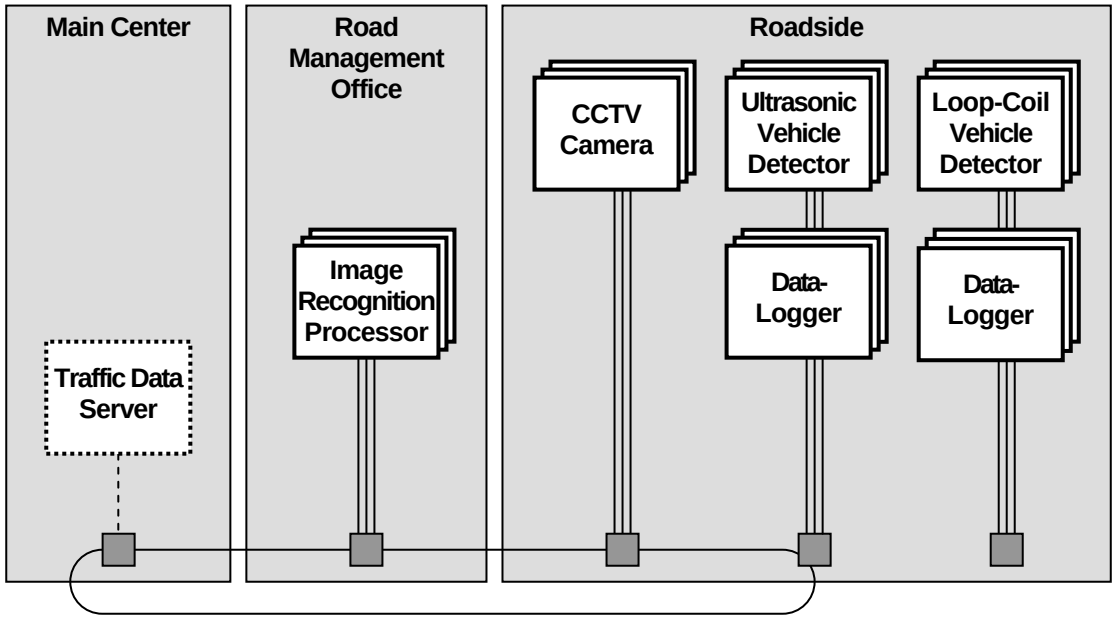
4. Requirements

- System shall be capable of measuring number of vehicles, vehicle speed and vehicle length at a specific point on the road.
- System shall be capable of notifying the measured results automatically and promptly to the Main Center and road management office.
- System shall be capable of identifying the time and place of measured values at the Main Center road and management office.
- System shall be capable of allowing installing roadside equipment adequately at important points on the main line of expressways and the tollgates.
- System shall be capable of allowing securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

5. System Architecture

System architecture for vehicle detection is shown below.

Figure 5.1 System Architecture for Vehicle Detection



: Location : Equipment Package : Detailed Device

: Software

Broken Lines: Outside of This Functional Package

6. Loop-coil Vehicle Detector

6.1 Functions

- To measure required data for compiling at least the following traffic data.

  - Traffic volume (by all lanes, by one lane, by vehicle category and by every 5 minute)

  - Average speed (for every 5 minute, 15 minutes, 1 hour)

  - Vehicle Length

- To transmit the measured data to “Traffic Data Server”.
- To operate continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- To synchronize its clock to the clock of “Traffic Supervising / Control Server” at the start-up.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoor.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow performing maintenance works from the it’s sides and/or back, but not from lane direction, in order to minimize the influence to traffic activities.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices

6.3 Performance

- The equipment components shall be capable of transmitting measured Traffic Data to “Traffic Event Data Server”.
- Data elements and their attributes, including the use case of exchanging messages,

shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).

6.4 Communication Interface

- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

6.5 Human Machine Interfaces

- The system shall have the function to output test data to personal computers at site so that installation staff may adjust the detection range.

6.6 Installation

- The equipment components consist of an amplifier, a data logger and coiled wire.
- The amplifier and the data logger shall be located in the chassis on roadside. The coiled wires shall be embedded in the pavement.
- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.

7. CCTV Camera

7.1 Functions

- The system shall be capable of monitoring vehicles on the expressway and identifying types of the vehicles by their appearances.
- The system shall be capable of taking an image of vehicle license number plate upon control signal.
- CCTV shall be capable of automatically correcting brightness of captured image. (That is called the iris function.)
- CCTV shall have auto-focus function to be controlled by using “CCTV Monitor Console”.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The equipment components shall be capable of synchronizing its clock to the clock of “Traffic Supervising / Control Server” at start-up.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with the measures against water, rust, dust, salt water in case equipment components are installed outdoors.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow maintenance works from the sides and/or back, but not from lane direction, in order to minimize the influence to traffic activities.
- The chassis of equipment shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with the measures against interference from other electronic devices.
- CCTV camera shall be protected against dust and water ingress if it will be installed outdoors in road typical section in accordance with IP66 of the international standards IEC 60529 or equivalent.
- The camera shall be capable of complying with CS–mount standards.

7.3 Performance

- The equipment components shall be capable of taking images road traffic by at least Black/White image for continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The equipment components shall be capable of setting the shutter speed when capturing the image of vehicle license number plate.
- The equipment components shall be capable of transmitting the image of vehicle license number plate to “Image Recognition Processor”.
- Width of image sensor must be greater than 1/4".
- Minimum focal length of lens must be between 3.0mm and 5.0mm, and may be changed based on CS mount lens.
- The camera resolution must be greater than 1 mega pixel or 1280x720.
- The minimum illumination in day mode and night mode should be lower than 1.0 lx and 0.1 lx respectively, without slow shutter function.
- The camera must be capable of encoding in H.264, MPEG4-Part2 and Motion JPEG.
- The camera shall be protected in accordance with IP66, ISO/IEC 60529.
- The frame rate should be greater than 25 fps.
- The camera must consumed power less than 50W.
- The camera can operate at -30 to 50 degrees with humidity range from 20 to 90% (non-condensing).
- The device’s weight should be lesser than 4.0 kg.
- The system shall be capable of fully meeting the requirements even under night conditions.

7.4 Human Machine Interfaces

- CCTV camera shall have the function to output test image to personal computers at site so that installation staff may adjust the direction of the camera.
- The system shall have video image output interface to adjust angle of view of camera and receiving control signal interface to check camera operations at setup at installation site.

7.5 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure

- Data transmission procedure
- Timing chart and other details of the standard interfaces

- The camera should use 10BASE-T/100BASE-TX interfaces.
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

7.6 Installation

- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- CCTV cameras shall be installed so that direction of camera may not be rotated by strong wind.
- CCTV camera shall be installed so that images may not swing by strong wind.
- CCTV camera shall be capable of being vertically and horizontally adjusted during installation at roadside.
- Horizontal and vertical angle of CCTV camera shall be capable of being adjusted and fixed appropriately at the installation site.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.
- In case of more than one camera are attached on the same pole, each camera shall be attached with at least 1m height interval.
- The camera should be installed 7-8m above ground level in accordance with the limit construction clearance in accordance with TCVN 4054:2005 and TCVN 5729.
- The camera need to be installed in case of disrupting vision obstacles such as flyover bridge, longitudinal gradient of road, roadside cutting slope, overbridges, buildings, trees, lighting poles, traffic signs, VMS, alignment of road, tollgate, etc.
- The equipment components shall be appropriately installed at interval locations between interchanges and junctions.
- The camera should be installed at each side of the road.
- The cameras shall be installed with the maximum surveillance area to shoot the image of vehicles
- The equipment component shall be supplied with Device Driver for controlling camera functions. ONVIF compliance is required for CCTV cameras.
- In case the equipments to be located at outdoor, the screw for attachment should be antitheft type.

8. Image Recognition Processor

8.1 Functions

- The system shall be capable of measuring required data for compiling at least the following traffic data:
  - Traffic volume (by all lanes, by one lane, by vehicle category and by hour)
  - Average speed (for every 1 minute, 15 minutes, 1 hour)
  - Vehicle Length
- The equipment components shall be capable of synchronizing its clock to the clock of "CCTV Monitoring Console" at the start-up.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The Image Recognition Processor shall have sufficient durability for 24hours a day, 365 days a year.
- The Image Recognition Processor shall have the structure which is possible to fix in the building to Road Management Office.
- The structure of Image Recognition Processor shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of Image Recognition Processor shall be capable to implement the periodical checking and clean-up activities.

8.3 Performance

- Distance of Recognition: equivalent to Installation height of CCTV x 10 times or over
- The equipment components shall be capable of transmitting the measured Traffic Data to

"Traffic Event Data Server".

- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The equipment of components shall be capable of discretionarily setting the unit time of recording volume, average speed, occupancy and traffic flow speed.
- The system shall have video image output interface to adjust angle of view of camera and control signal receiving interface to check camera operations for setting-up at installation site.
- The system shall be capable of controlling the lens aperture per the brightness of the subject and of outputting good quality video image.

8.4 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

8.5 Installation

- Image recognition can be installed into Fixed type camera with specification mentioned at Article 7.
- The equipment of components shall be installed at each Road Management Office.
- The total number of equipments estimated to install depends on the number of cameras for using Vehicle Detection.
- The software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be

considered as the part of the installation work.

- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

9. Ambient Conditions

- The equipment components shall be installed in the offices, toll booth, outside and shall be protected from interference of other electronic devices.
- The equipment components shall be capable of operating normally under the following ambient conditions:

For Main Center, Toll Management Center, and Toll Office
Temperature: 25 +/- 3 degree C in average
Relative humidity: between 20 and 80 % in average
For outside
Temperature: between - 0 and +50 degree C
Relative humidity: below 95 %

10. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

11. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The system shall be capable of identifying the faulty parts easily in case equipment fault is detected, and the replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary

for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.

- The manufacturer of the equipment components shall make a contract for technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer shall provide the necessary services based on the contract.

12. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit the copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

13. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions:

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory test procedure and its inspection procedure shall be

submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the

consultant

(4) The necessary number of submission documents

(5)
Traffic Analysis

1. General Outline

This functional package allows the road operators to keep track of traffic conditions on the expressways, such as crowdedness and vehicle velocity, by processing and analyzing the data captured by vehicle detectors.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed in the Main Centres of the expressway network for activating functional packages.

3. Relevant Regulations and Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries

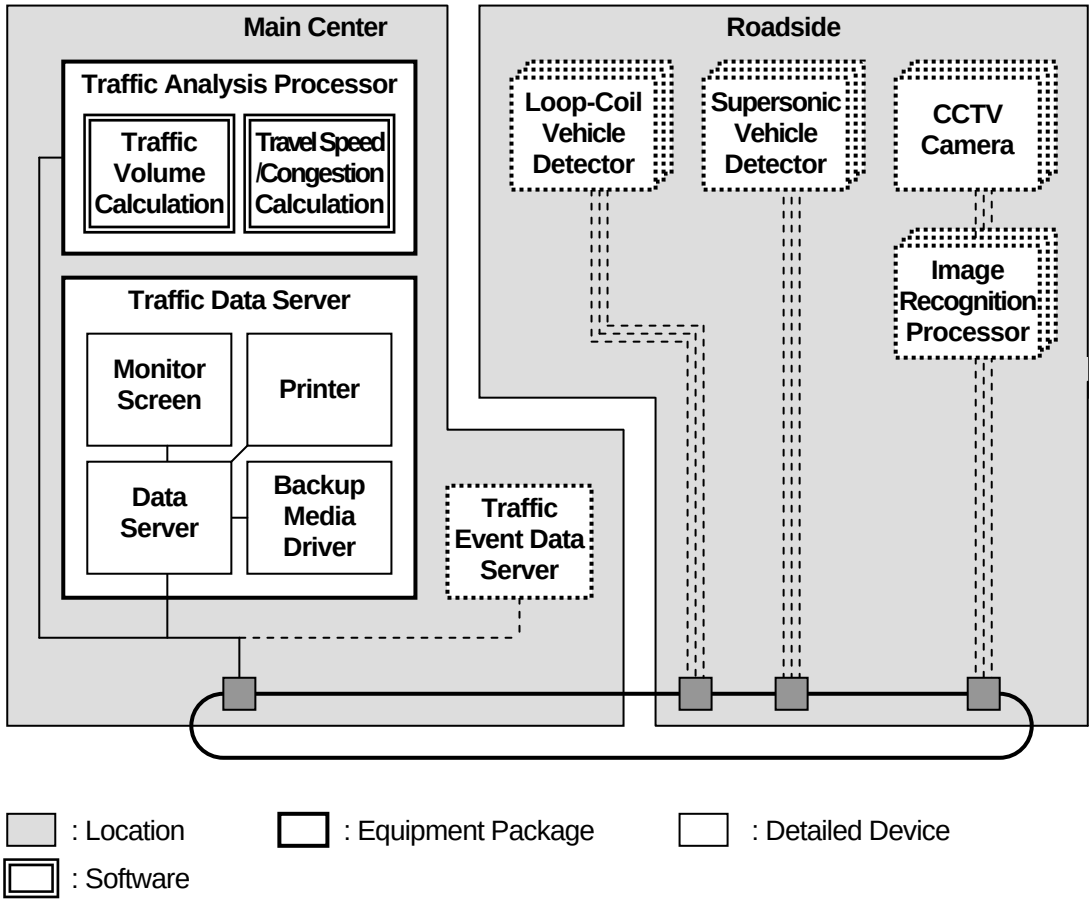
4. Requirements

- System shall be capable of calculating the traffic volume and Ratio of heavy vehicle on expressway based on the results obtained from Vehicle Detection installed in appropriate points.
- System shall be capable ofcalculating the average speed and traffic congestion status with the precision usable for traffic information provision and inflow regulation. Based on the results obtained from Vehicle Detection installed in appropriate points:
- System shall be capable of compiling the calculation results and the measured results by vehicle detectors as statistic values for developing road improvement plans.
- System shall be capable of storing the calculation results and the measured results by vehicle detectors as the data for every 1 minute in a database.
- System shall be capable of indicating and printout the needed results.
- System shall be capable of allowing securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

5. System Architecture

System architecture for traffic analysis is shown below.

Figure 5.1 System Architecture for Traffic Analysis



6. Traffic Analysis Processor (Traffic Volume Calculation)

6.1 Functions

- Software shall be capable of counting traffic volume at a specific point on the road based on the measurements by vehicle detectors.
- Software shall be capable of calculating heavy vehicle ratio at a specific point on the road based on the measurements by vehicle detectors.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices
- The Traffic Analysis Processor (Traffic Volume Calculation) shall have sufficient durability for 24hours a day, 365 days a year.
- The Traffic Analysis Processor (Traffic Volume Calculation) shall have the structure which is possible to fix in the building in Regional Main Center.
- The structure of Traffic Analysis Processor (Traffic Volume Calculation) shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Traffic Analysis Processor (Traffic Volume Calculation) shall be capable to implement the periodical checking and clean up activities.

6.3 Performance

- Software shall be capable of automatically calculating the traffic volume by vehicle types (i.e. by vehicles having length of from 12.0 m and above or less) at each specific point in every one (1) minute, and the calculated results shall be stored in the Traffic Data Server.
- Software shall be capable of categorizing vehicles types by their vehicle length (i.e. standard-size vehicle, having length less than 12.0 m and heavy vehicle, having length 12.0 m or more. And also calculating the total traffic volume of each type.
- Software shall be capable of automatically updating the traffic data (such as 5 minutes traffic volume, 15 minutes traffic volume) every 1 minute.

- Software shall be capable of automatically preparing the statistical data related to traffic volume, based on the traffic data stored in the Traffic Data Server. Necessary statistical data is monthly, daily and hourly traffic volume of each vehicle type.
- At least, the software shall be capable of calculating following traffic data:

  - Traffic volume (of all lanes, each lane, vehicle type and every 5 minutes, 15 minutes, 1 hour)
  - Hourly traffic volume of each vehicle type, each lane within the total time of a year (24 hours x 365 days x 5 years = 43800 hour)
  - Daily traffic volume of each vehicle type, each lane within the total day of 10 years (365 days x 10 years = 3650 days)
  - Monthly traffic volume of each vehicle type, each lane within the total month of 10 years (12 months x 10 years = 120 months)
  - Yearly traffic volume of each vehicle type, each lane within the total year of 20 years

- Software shall be capable of receiving the detected Traffic Data from “Vehicle Detector”.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- Software shall be capable of displaying the calculated results of traffic data into table and chart formats.
- Software shall be capable of transmitting the calculated result of traffic data to “Traffic Event Data Server”.
- Software shall be capable of saving the compiled data in CSV form. It shall be capable of being accessed and modified by using commercially application software (such as Microsoft Excel).

6.4 Human Machine Interface

- Software shall be capable of using a human machine interface for displaying the following statistical data on the screen and printing it out:

  - Yearly Traffic volume of each vehicle type at specific point on the expressway
  - Monthly Traffic volume of each vehicle type at specific point on the expressway
  - Daily Traffic volume of each vehicle type at specific point on the expressway
  - Hourly Traffic volume of each vehicle type at specific point on the expressway
  - 15 minutes Traffic volume of each vehicle type at specific point on the expressway
  - 5 minutes Traffic volume of each vehicle type at specific point on the expressway

6.5 Communication Interface

- The system shall be capable of transmitting the all data and signals over TCP/IP.
- The system shall have the following communication interfaces between transmission

devices:

- Bit allocation, which is needed for designing data transmission between transmission devices
- Bit transmission procedure
- Data transmission procedure
- Timing chart and other details of the standard interfaces

- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

6.6 Installation

- Software shall be capable of being installed on the operating system such as Windows or Linux which is widely available in many countries.
- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Traffic Analysis Processor (Traffic Volume Calculation) shall be installed in air conditioned room in Regional Main Center.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

7. Traffic Analysis Processor (Speed/Congestion Calculation)

7.1 Functions

- Software shall be capable of automatically calculating average speed at Vehicle Detector installation point, which is 500 m from the front of the junction, based on the results obtained from Vehicle Detector and Image Recognition Device.
- Software shall be capable of comparing calculated average speed at Vehicle Detector installation site with threshold, which is 500 m from the front of the junction, and determining whether there is traffic congestion or not.
- Software shall be capable of automatically calculating average speed (km/h) at Vehicle Detector installation point every one minute, which is 500 m from the front of the junction, and storing in Data Server, based on the speed data of each vehicle obtained from Vehicle Detector and Image Recognition Device.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The Traffic Analysis Processor (Speed/Congestion Calculation) shall have sufficient durability for 24hours a day, 365 days a year.
- The Traffic Analysis Processor (Speed/Congestion Calculation) shall have the structure which is possible to fix in the building in Regional Main Center.
- The structure of Traffic Analysis Processor (Speed/Congestion Calculation) shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Traffic Analysis Processor (Speed/Congestion Calculation) shall be capable to implement the periodical checking and clean up activities.

7.3 Performance

- The software shall be capable of automatically identifying traffic congestion based on the condition that the vehicles are lined up 1 km with driving speed under 40 km/h continuously for more than 15 minutes, based on one-minute basis average speed detection result at Vehicle Detector's installation point, which is 500 m from the front of

the junction.

- Software shall be capable of automatically identifying heavy traffic if the driving speed is under 50 km/h continuously for more than 15 minutes based on the results of one-minute calculated average speed.
- Software shall be capable of storing the identified result of congestion to the Traffic Data Server together with its average speed. In case, the identified result is categorized as traffic congestion, it shall be transmitted to the Traffic Event Data Server and include the data of congested section of the expressway, time and average speed.
- Software shall be capable of automatically updating the average speed every 1 minute. And also identifying heavy traffic every 1 minute.
- Software shall be capable of automatically calculating statistical data based on the stored individual vehicle speed data in Traffic Data Server. The statistical data shall include the following data for individual representative points:

  - Yearly average speed at a specific point on the expressway
  - Monthly average speed at a specific point on the expressway
  - Daily average speed at a specific point on the expressway
  - Hourly average speed at a specific point on the expressway
  - 15 minutes average speed at a specific point on the expressway
  - 5 minutes average speed at a specific point on the expressway
- Software shall be capable of receiving the detected Traffic Data from “Vehicle Detector”.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- Software shall be capable of displaying the calculation result of average speed of each specific point into table and chart formats.
- Software shall be capable of transmitting the calculation result of traffic data to “Traffic Event Data Server”.
- Software shall be capable of saving the compiled data in CSV form. It shall be capable of being accessed and modified by using commercially application software (such as Microsoft Excel).

7.4 Human Machine Interface

- If the calculated average speed data exceeds the threshold, the fact shall be notified to the operator with human machine interface such as buzzer or appropriate screen display.
- Software shall be capable of using a human machine interface for displaying the following calculation result on average speed of the expressway (monthly, daily, hourly), traffic congestion condition, on the screen and printing it out;
  - Yearly average speed of each vehicle type at specific point on the expressway

- Monthly average speed of each vehicle type at specific point on the expressway
- Daily average speed of each vehicle type at specific point on the expressway
- Hourly average speed of each vehicle type at specific point on the expressway
- 15 minutes average speed of each vehicle type at specific point on the expressway
- 5 minutes average speed of each vehicle type at specific point on the expressway

7.5 Communication Interface

- The system shall be capable of transmitting the all data and signals over TCP/IP.
- The system shall have the following communication interfaces between transmission devices:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

7.6 Installation

- Software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely used in many countries.
- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Traffic Analysis Processor (Speed/Congestion Calculation) shall be installed in air conditioned room in Regional Main Center.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

8. Traffic Data Server

8.1 Functions

- The Traffic Data Server shall be capable of displaying and printing out the stored traffic volume, average speed, and identified result of congestion, when it is required.
- The Traffic Data Server shall be capable of making backup of the stored data.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices
- The Traffic Data Server shall have sufficient durability for 24hours a day, 365 days a year.
- The Traffic Data Server shall have the structure which is possible to fix in the building in Regional Main Center.
- The structure of Traffic Data Server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Traffic Data Server shall be capable to implement the periodical checking and clean up activities.

8.3 Performance

- The equipment shall be capable of transmitting the data of average speed and time, location ID which is identified as congestion to the Traffic Event Data Server.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The Data Server shall have storage capacity to store at least five(5) years data on traffic volume, average speed, and congestion condition.
- The Data Server shall have storage capacity to store at least following data:

  - 1 minute data on traffic volume more than 24 hours
  - 1 minute data on average speed more than 24 hours

- 5 minute and 15minutes data on traffic volume more than 1 month
- 5 minute and 15minutes data on average speed more than 1 month
- Hourly data on traffic volume more than 5 years
- Hourly data on average speed more than 5 years
- Daily and monthly data on traffic volume more than 10 years
- Daily and monthly data on average speed more than 10 years
- Yearly data on traffic volume more than 20 years
- Yearly data on average speed more than 20 years
- Data of congestion condition more than 5 years

- The Data server shall be capable of executing backup of the stored data in the data server on the date which is set up in advance.
- The Data server shall be capable of executing the restoration of backup data.
- The Data Server shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).

8.4 Human Machine Interface

- The equipment shall have human machine interface in order to display stored traffic volume data, average speed, and traffic congestion information on the screen and print them out.
- The Traffic Data Server shall have equipments such as keyboard, joystick, trackball so that the operator can input necessary commands into the system.
- The traffic data server shall be capable of management by remote control.

8.5 Communication Interface

- The system shall be capable of transmitting the all data and signals over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

8.6 Installation

- Software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely used in many countries.

- The Traffic Data Server shall have database system such as Oracle or MySQL or etc.
- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Traffic Data Server shall be installed in air conditioned room in Regional Main Center.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

9. Ambient Conditions

- It is recommended that lighting condition of 200 lx is provided to allow easy operation and maintenance in the Main Center.
- The equipment components shall be installed in the offices and protected from interferences of other electronic devices.
- The equipment components shall be capable of operating normally under the following ambient conditions:

For Main Center, Toll Management Center, and Toll Office
Temperature: 25 +/- 3 degree C in average
Relative humidity: between 20 and 80 % in average
For outside
Temperature: between - 0 and +50 degree C
Relative humidity: below 95 % in average

10. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- System shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

11. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The system shall be capable to identify the faulty parts easily in case equipment fault is detected, and the replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.
- The manufacturer of the equipment components shall make a contract on technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer shall provide the necessary services based on the contract.

12. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit the copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

13. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions:

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of test such as factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be born by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant

3) Necessary Documents

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(6)
Weather Monitoring

1. General Outline

This functional package allows the road operators to estimate dangerous conditions for road traffic on the expressways by using data acquired by the sensors installed at the interchanges and at the road sections where undesired weather conditions for traffic safety frequently take place.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, and in the Main Centers of the expressway network for activating functional packages.

3. Relevant Regulations and Standards

1) International Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sensor – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- WMO-No.544 Manual on the Global Observing System (WMO)
- IEC 60529: Degrees of Protection provided by Enclosure (IP Code)
- BS 7430: Earthing
- BS 6651: Lightning Protection

2) National Standards

- TCVN 4054
- TCVN 5729

4. Requirements

- System shall be capable of measuring rainfall, wind speed, visibility, and air temperature.
- System shall be capable of automatically and promptly sending the measured results to the Regional Main Center.
- System shall be capable of allowing identifying the time and place of measured values

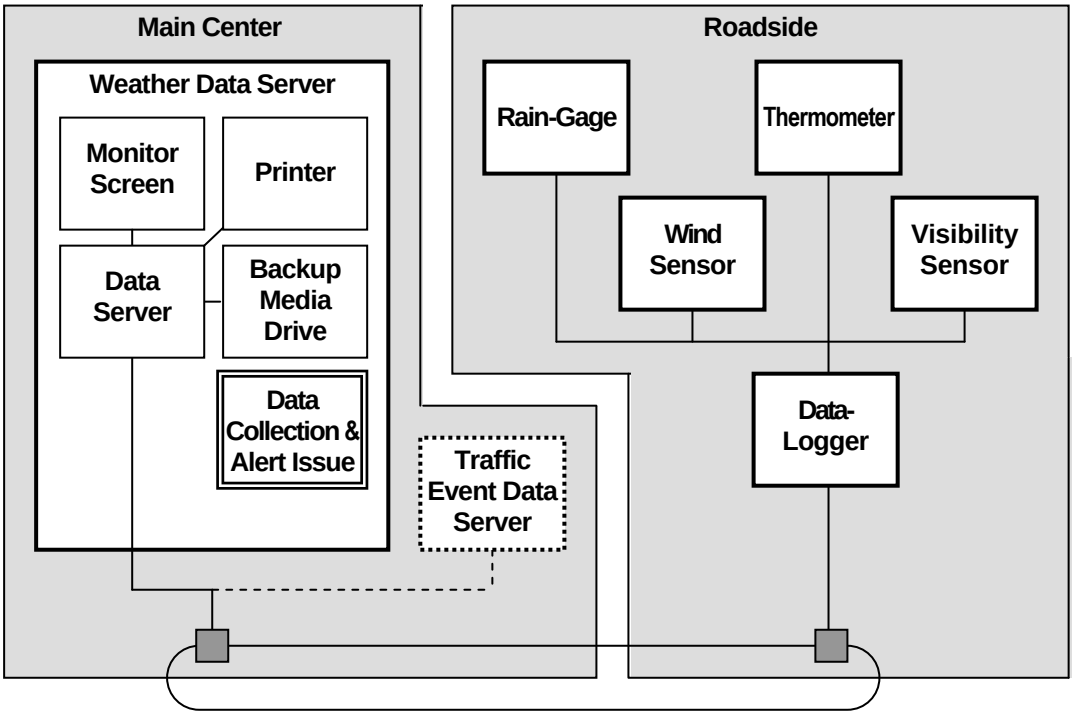
at the Regional Main Center.

- System shall be capable of storing the measured results as the data for every 5 minutes in a database.
- System shall be capable of indicating and printing out the needed results.
- System shall be capable of automatically and promptly sending a warning to the Regional Main Center in case that a measured result is beyond the limit defined in advance.
- System shall be capable of allowing installing sensors adequately at interchanges and important points on the expressways.
- System shall be capable of allowing securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

5. System Architecture

System architecture for weather monitoring is shown below.

Figure 5.1 System Architecture for Weather Monitoring



6 Rain Gauge

6.1 Functions

- Rain gauge shall be capable to observe precipitation with the performance specified in item 6.7.3.
- The observed data shall be capable to be updated every 5 minutes.
- Accumulated amount of precipitation shall be calculated based on the 5 minutes observed data and the result shall be capable to be stored
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoor.
- The chassis of equipment components shall not be opened easily.
- The equipment components shall allow performing maintenance works from its sides and/or back, but not from lane direction, in order to minimize the influence to traffic ativities.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The structure of rain gauge and related equipment component such as connecting cables shall be capable to withstand natural conditions, meteorological conditions, electromagnetic noise, and other environmental conditions in Vietnam.

6.3 Performance

- Performance of rain gauge shall be as per the following conditions:

  a) Observation range : measureable min. 200 mm/h
  b) Sensitivity : 0.5 mm
  c) Accuracy : max. +/- 0.5mm (up to 20 mm/h)
  : max. +/- 3% (more than 20 mm/h up to 100 mm/h)
  d) Funnel diameter : 200– 260 mm

- Accuracy of censor shall be verified before delivery.

6.4 Communication Interfaces

- Communication interfaces shall be properly selected to function well on data and signal transmission between rain gauge and data logger which collects observed precipitation data at site where weather sensors are installed.

6.5 Installation

- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The rain gauge shall be installed to obtain the necessary meteorological observation data for expressway operation.
- The rain gauge and related equipment components shall be installed outside of guard rail where it is not affected by expressway operation, and it is suitable for operation and maintenance of the rain gauge and related equipment components such as data logger.
- The rain gauge shall be installed approx. 3.0 - 3.5 height.
- The installation work shall include equipment component’s unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The site where the equipment component is installed shall be protected so that the general public can not access to the equipment component easily.

7. Wind Sensor

7.1 Functions

- Wind sensor shall be capable to measure wind speed with the performance specified in item 7.3.
- The observed data shall be capable to be updated every 5 minutes.
- Average, maximum, minimum values shall be calculated based on the 5 minutes observed data and those data shall be capable to be stored.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoor.
- The chassis of equipment components shall not be opened easily.
- The equipment components shall allow performing maintenance works from its sides and/or back, but not from lane direction, in order to minimize the influence to traffic ativities.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The structure of wind sensor and related equipment component such as connecting cables shall be capable to withstand natural conditions, meteorological conditions, electromagnetic noise, and other environmental conditions in Vietnam.

7.3 Performance

- Performance of wind speed sensor shall be as per the following conditions:

  Wind speed sensor
  a) Measuring range : 2 to 50 m/sec
  b) Resolution : 0.1 m/sec
  c) Accuracy : within +/- 3%

- Accuracy of censor shall be verified before delivery.

7.4 Communication Interfaces

- Communication interfaces shall be properly selected to function well for data and signal transmission between wind sensor and data logger which collects observed wind speed data at site where weather sensors are installed.

7.5 Installation

- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The wind sensor shall be installed to obtain necessary meteorological observation data for expressway operation.
- The wind sensor and related equipment components shall be installed outside of guard rail where it is not affected by expressway operation, and it is suitable for operation and maintenance of the wind sensor and related equipment components such as data logger.
- The wind speed sensor shall be installed 3.5 – 5 m height.
- The installation work shall include equipment component’s unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The site where the equipment component is installed shall be protected so that the general public can not access to the equipment component easily.

8. Visibility Sensor

8.1 Functions

- Visibility sensor shall be capable to observe visibility with the performance specified in item 6.9.3.
- The observed data shall be capable to be updated every 5 minutes.
- Average, maximum, minimum values shall be calculated based on the 5 minutes observed data and those data shall be capable to be stored.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoor.
- The chassis of equipment components shall not be opened easily.
- The equipment components shall allow performing maintenance works from its sides and/or back, but not from lane direction, in order to minimize the influence to traffic ativities.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The structure of visibility sensor and related equipment component such as connecting cables shall be capable to withstand natural conditions, meteorological conditions, electromagnetic noise, and other environmental conditions in Vietnam.

8.3 Performance

- Performance of visibility sensor shall be as per the following conditions:

  Visibility sensor
  a) Measuring range : MOR[1] 10 – 2,000 m
  b) Accuracy : +/- 10 % (up to 2,000 m)

- Accuracy of censor shall be verified before delivery.

[1] MOR: Meteorological Optical Range

8.4 Human Machine Interfaces

- Maintenance equipment component or measuring tool which check visibility sensor performance shall be equipped with necessary Human Machine Interface.

8.5 Communication Interfaces

- Communication interfaces shall be properly selected to function well for data and signal transmission between visibility sensor and data logger which collects observed visibility data at site where weather sensors are installed.
- Visibility sensor shall have the function to output test sensor to personal computers at site so that installation staff may adjust the direction on the sensor.

8.6 Installation

- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The visibility sensor shall be installed to obtain necessary meteorological observation data for expressway operation.
- The visibility sensor and related equipment components shall be installed outside of guard rail where it is not affected by expressway operation and it is suitable for operation and maintenance of the wind sensor and related equipment components such as data logger.
- The visibility sensor shall be installed 1.5 - 2.5 m height;
- The installation work shall include equipment component’s unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The site where the equipment component is installed shall be protected so that the general public can not access to the equipment component easily.

9. Thermometer

9.1 Functions

- Thermometer shall be capable to observe air temperature with the performance specified in item 9.3.
- The observed data shall be capable to be updated every 5 minutes.
- Average, maximum, minimum values shall be calculated based on the 5 minutes observed data and those data shall be capable to be stored.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

9.2 Structure

- The equipment components shall have adequate structure to minimize affection of heat such as radiation, reflection and others except for the air temperature.
- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoor.
- The chassis of equipment components shall not be opened easily.
- The equipment components shall allow performing maintenance works from its sides and/or back, but not from lane direction, in order to minimize the influence to traffic ativities.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The structure of thermometer and related equipment component such as connecting cables and housing shall be capable to withstand natural conditions, meteorological conditions, electromagnetic noise, and other environmental conditions in Vietnam.

9.3 Performance

- Performance of thermometer shall be as per the following conditions:

  Thermometer for air temperature
  a) Measuring range : -10 to 60 degree centigrade
  b) Resolution : 0.1 degree -10 to 60 degree centigrade
  c) Accuracy : +/- 0.2 degree centigrade (at +20 degree centigrade)
  d) Type : Pt 100

- Accuracy of censor shall be verified before delivery.

9.4 Human Machine Interfaces

- Maintenance equipment component or measuring tool which check thermometer performance shall be equipped necessary Human Machine Interface.
- Thermometer shall have the function to output test sensor to personal computers at site so that installation staff may adjust the thermometer.

9.5 Communication Interfaces

- Communication interfaces shall be properly selected to function well for data and signal transmission between thermometer and data logger which collects observed air temperature data at site where weather sensors are installed.

9.6 Installation

- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The thermometer shall be installed to obtain necessary meteorological observation data for expressway operation.
- The thermometer and related equipment components shall be installed outside of guard rail where it is not affected by expressway operation and it is suitable for operation and maintenance of the wind sensor and related equipment components such as data logger.
- The thermometer shall be installed 1.5 – 2.0 m height.
- The installation work shall include equipment component’s unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.

- The site where the equipment component is installed shall be protected so that the general public can not access to the equipment component easily.

10. Data Logger

10.1 Functions

- The data logger shall be capable to collect observed data from each sensor.
- The data logger shall be capable to convert raw data obtained from each sensor to the format which is able to process statistically.
- The data logger shall be capable to calculate average, maximum, minimum values for wind speed, visibility, temperature, and accumulated amount of precipitation based on the 5 minutes observed data, and the data logger shall be capable to store the calculation result.
- Data logger shall be capable to transmit the stored calculation data mentioned above in response to the request from Weather Data Server to be installed in Regional Main Center.
- If weather sensor is equipped with own clock, the data logger shall be capable to synchronize it with data logger's own clock. The data logger shall be capable to keep the synchronization with the Weather Data Server.
- The data logger shall be capable to detect the failure of weather sensors whenever it happens. The data logger shall be capable to detect its own failure whenever it happens.
- The data logger shall be capable to detect the data which is out of measuring range or unclear, and shall be capable to identify it.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

10.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoor.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow performing maintenance works from its sides and/or back, but not from lane direction, in order to minimize the influence to traffic

activities.

- The equipment components shall be protected with measures against interference from other electronic devices.
- The data logger shall be installed in the enclosure or chassis, and the structure of data logger and enclosure/chassis shall be capable to withstand natural conditions, meteorological conditions, electromagnetic noise, and other environmental conditions in Vietnam.

10.3 Performance

- The data logger shall be capable enough to perform necessary functions stipulated in item 10.1.
- The data logger shall be capable to store the above calculation result for at least two (2) hours.
- The data logger shall be synchronized with Weather Data Server and the sensor which is equipped with its own clock.

10.4 Human Machine Interfaces

- The data logger shall be equipped with Human Machine Interface necessary for operation and maintenance such as keyboard for inputting commands to check weather sensors and its own operating conditions, and screen which displays the result.
- The data logger shall be capable to check weather sensor and its own operating conditions through input devices, and shall be capable to display the result on screen.

10.5 Communication Interfaces

- The system shall be capable of transmitting all data and signals over TCP/IP between data logger and Weather Data Server.
- Communication interfaces shall be properly selected to function well for data and signal transmission between weather sensors and data logger.
- The data logger shall be equipped with Ethernet interface as required between the data logger and communication node.

10.6 Installation

- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The data logger shall be installed outside of guard rail where it is not affected by expressway operation and it is suitable for operation and maintenance.

- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The site where the equipment component is installed shall be protected so that the general public can not access to the equipment component easily.

11 Weather Data Server

11.1 Functions

- Weather data server to be located in the main center shall be capable to display each location of the observation site clearly on the topographic map on the connected screen to the server. The observation site shall be clearly identifiable by the operator.
- The weather data server shall be capable to display on server data such as each site and as each observation element.
- The weather data server shall be capable to display each observed element data at each site on the topographic map.
- The weather data server shall be capable to collect observed data from each site and capable to update displayed data in every 5 minutes.
- The weather data server shall be capable to compile collected observed data into database.
- The weather data server shall be capable to detect when observed precipitation, wind speed or air temperature exceeds the corresponding threshold, or when the observed visibility becomes shorter than the threshold. The detected result shall be notified to the operator with buzzer and alert on the screen immediately after it is detected.
- When observed precipitation, wind speed, air temperature exceeds the corresponding threshold, or in case observed visibility becomes shorter than the threshold, this detected result shall be capable to be recorded in the Traffic Event Data Server.
- The weather data server shall be capable to monitor the operating conditions of the

weather sensors and related equipment components such as data logger, and it shall be capable to identify whether failure is detected in each equipment component or not.

- The weather data server shall be capable to search compiled data, and searched result shall be capable to be displayed on the screen.
- The weather data server shall be capable to record the compiled data to the external storage device.
- The weather data server shall be capable to change the threshold value to sound the buzzer from input devices.

11.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices
- The Weather Data Server shall have sufficient durability for 24hours a day, 365 days a year.
- The Weather Data Server shall have the structure which is possible to fix in the building in Regional Main Center.
- The structure of Weather Data Server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Weather Data Server shall be capable to implement the periodical checking and clean up activities.

11.3 Performance

- The Weather data server shall be capable to perform necessary functions stipulated in item 11.1.
- The weather data server shall be synchronized with all data loggers
- The Data Server shall have storage capacity to store at least five(5) years data on traffic volume, average speed, and congestion condition.
- The Data Server shall have storage capacity to store at least following data;

  - 5 minutes data on precipitation more than 24 hours

- 10 minutes data on wind speed more than 24 hours
- 15 minutes data on visibility more than 24 hours
- 5 minutes data on temperature more than 24 hours
- Hourly data on precipitation more than 1 month
- Hourly data on temperature more than 1 month
- Daily and monthly data on precipitation more than 10 years
- Daily and monthly data on wind speed more than 10 years
- Daily and monthly data on visibility more than 10 years
- Daily and monthly data on temperature more than 10 years
- Yearly data on precipitation more than 20 years
- Yearly data on wind speed more than 20 years
- Yearly data on visibility more than 20 years
- Yearly data on temperature more than 20 years

- The Data server shall be capable of executing backup of the stored data in the data server on the date which is set up in advance.
- The Data server shall be capable of executing the restoration of backup data.
- The Data Server shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).

11.4 Human Machine Interfaces

- If the observed weather data exceeds the threshold, the fact shall be notified to the operator with human machine interface such as buzzer or appropriate screen display.
- The weather data server shall be equipped necessary human machine interface such as monitor screen, keyboard and mouse.
- Software shall be capable of using a human machine interface for displaying the following calculation result on weather data of the expressway (monthly, daily, hourly) on the screen and printing it out;

  - Yearly average speed of each vehicle type at specific point on the expressway
  - Hourly precipitaton at specific point on the expressway
  - Daily precipitation at specific point on the expressway
  - Monthly precipitation at specific point on the expressway
  - Yearly precipitation at specific point on the expressway
  - 10 minutes average and maximum wind speed at specific point on the expressway
  - Hourly average and maximum wind speed at specific point on the expressway
  - Daily average and maximum wind speed at specific point on the expressway
  - Monthly average and maximum wind speed at specific point on the expressway
  - 15 minutes average and minimum visibility at specific point on the expressway
  - Daily average and minimum visibility at specific point on the expressway
  - 5 minutes average and maximum and minimum temperature at specific point on the expressway

- Hourly average and maximum and minimum temperature at specific point on the expressway
- Daily average and maximum and minimum temperature at specific point on the expressway
- Monthly average and maximum and minimum temperature at specific point on the expressway
- Yearly average and maximum and minimum temperature at specific point on the expressway

- The weather data server shall be capable of management by remote control.

11.5 Communication Interfaces

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The Weather Data Server shall be equipped necessary interface such as Ethernet interface to connect to the network of Main Center.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

11.6 Installation

- Software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely used in many countries.
- The Weather Data Server shall have database system such as Oracle or MySQL or etc.
- The Weather Data Server shall be installed in air conditioned room in Regional Main Center.
- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing

protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.

- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

12. Ambient Conditions

- In case the equipment component such as data logger is to be installed outside, it shall be installed in the cabinet or chassis of IP65 or equivalent in order to secure the proper performance of the equipment component.
- The weather sensor and the equipment component to be installed outside shall be capable to withstand natural conditions, meteorological conditions, electromagnetic noise, and other environmental conditions in Vietnam.

13. Power supply

- The electric power supply for weather sensors and related equipment components shall be equipped with backup power supply for securing continuous operation of the equipment components, except for the maintenance period.

14. Maintainability

- The equipment components shall be maintained easily and simply
- The weather monitoring equipment components and related system shall be capable to identify the faulty parts easily when detected, and the faulty parts shall be replaceable.
- The spare parts of weather monitoring equipment components and related system shall be available at least five (5) years after the equipment components are handed over to the road management authority, and the supply period of the spare parts shall be guaranteed by the manufacturer.
- The manufacturer of the weather monitoring equipment components and related system shall submit the necessary documents required for the operation and maintenance such as manuals and checklist, and provide necessary training to Operation and Maintenance staff of the related equipment components.
- The manufacturer/supplier of the weather monitoring equipment components and related system shall make a contract for technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer/supplier shall provide the necessary services based on the contract.

15. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit the copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.
- The weather observation sensors shall be verified before delivery, and the contractor/manufacturer shall be delivered with certificate of verification.
- The manufacturer shall be required to have some similar experiences of developing software for Weather Data Server specified above, and the manufacturer shall be required to submit a copy of the document of the successful delivery such as certificate of completion issued by the client attached with tender or prequalification proposal. In addition, several screen images of the delivered software shall be also submitted with a list of similar project experience attached with the tender or prequalification proposal.

16. Testing/Inspection

1) General

The Test and Inspection for the weather monitoring equipment components shall be implemented in accordance with the following conditions:

- The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.
- There are two types of tests: factory test and connection test of weather monitoring system. The connection test includes weather sensors, weather data server, and related equipment components.
- As for the inspection, the connection inspection is to be witnessed basically.
- Tests and Inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be born by the contractor, manufacturer, and/or the company in charge of installation work.
- Test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory test procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) Both connection test and its inspection procedure shall be submitted to the road management authority and the consultant

(4) After approval of the connection test procedure, the contractor's own connection test shall be executed and the test result shall be submitted to the road management authority and the consultant

(5) After approval of the inspection procedure, the inspection for the system connection shall be implemented witnessed by the road management authority and the consultant

3) Necessary Document

All procedures of the tests and the inspection shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the

tests and inspections, respectively in hard copy including followings;

- The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.
- In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

1) The submission deadline of each test and inspection procedure
2) The submission deadline of the contractor's own test result
3) The issuing deadline of related certificate from the road management authority and the consultant
4) The necessary number of submission documents

(7)
Traffic Event Data Management

1. General Outline

This functional package allows the road operators to conduct traffic control, regulation and information dissemination on the expressway, in the unified/integrated form, by categorizing the results acquired through emergency telephones, mobile radio communication, event detection, traffic analysis and weather monitoring and by organizing them as the data of traffic events corresponding to the place/time of occurrence and the priority.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed in the Main Centers and road management offices of the expressway network for activating functional packages.

3. Relevant Regulations and Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- ISO/CD 24533: Data directory and Message set for tracking of freight and It's intermodal transfer

4. Requirements

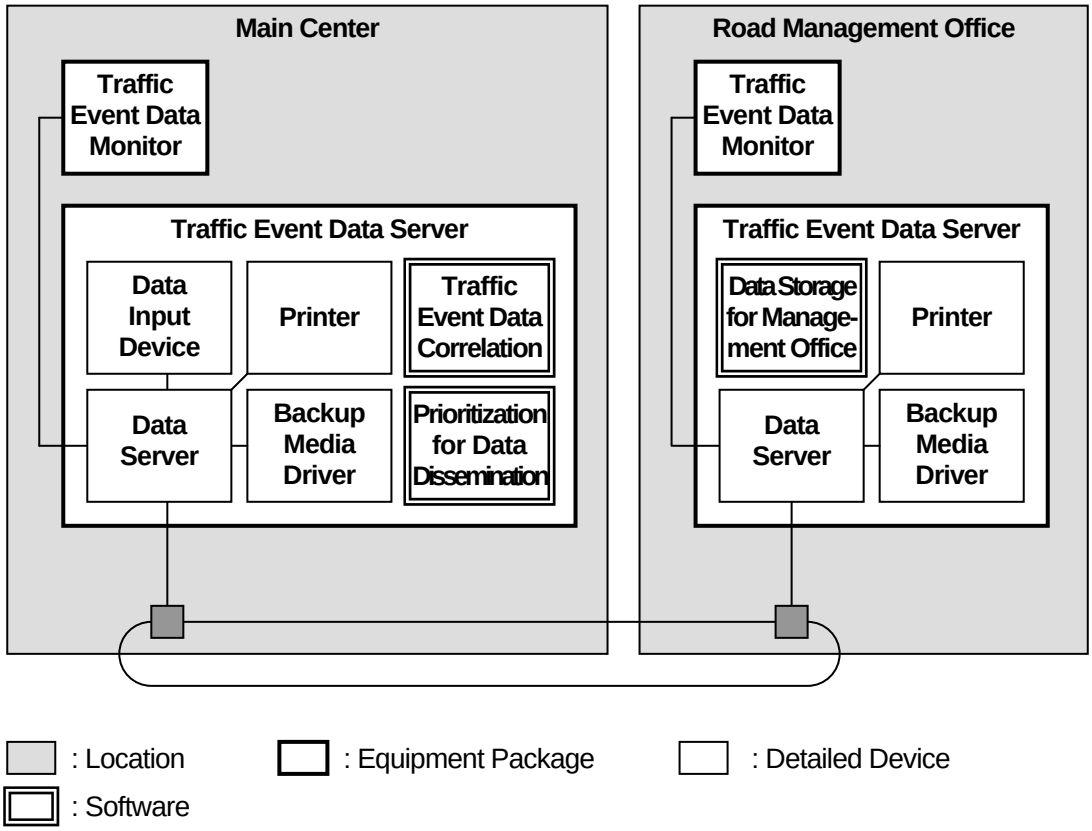
- System shall be capable of generating information in the form of traffic event from the results of CCTV monitoring, event detection, traffic analysis and weather monitoring.
- System shall be capable of generating the traffic event including traffic accidents, reverse driving, broken-down vehicle, left obstacle, natural disaster, vandalism, construction work, bad weather and congestion.
- System shall be capable of generating the traffic event including traffic restriction such as closure and speed limitation.
- System shall be capable of identifying the generated events by kilo-meter post of the road sections and date/time.
- System shall be capable of correlating a traffic event to its causual traffic event.
- System shall be capable of setting priorities on generated/correlated traffic events by their classes.
- System shall be capable of indicating the categorized events in Vietnamese and English.

- System shall be capable of storing the categorized events as the data for every 5 minutes in a database.
- System shall be capable of showing and printout the needed results.
- System shall be capable of functioning 24 hours a day, 365 days a year by a redundant system and sufficient durability/reliability of equipment components.

5. System Architecture

System architecture for traffic event data management is shown below.

Figure 5.1 System Architecture for Traffic Event Management



6. Traffic Event Data Server (Traffic Event Data Correlation)

6.1 Functions

- Software shall be capable of correlating and categorizing plural traffic event data with related data obtained by Event Detection, Traffic Analysis and Weather Sensors.
- Software shall be capable of inputting plural traffic event data.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The Traffic Event Data Server (Traffic Event Data Correlation) shall have sufficient durability for 24hours a day, 365 days a year.
- The Traffic Event Data Server (Traffic Event Data Correlation) shall have the structure which is possible to fix in the building in Regional Main Center.
- The structure of Traffic Event Data Server (Traffic Event Data Correlation) shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Traffic Event Data Server (Traffic Event Data Correlation) shall be capable to implement the periodical checking and clean up activities.

6.3 Performance

- Software shall be capable of automatically assigning serial number into Data Server in corresponding to the storing time of traffic event data which is obtained by Event Detection, Traffic Analysis and Weather Sensors.
- Software shall be capable of generating the “Correlated Traffic Event Data” that have a cause-and-effect relationship based on the input conditions from Traffic Supervision, and it shall be capable of storing them in Data Server.
- Software shall be capable of releasing the relationship of the Correlated Traffic Event Data after completion, based on the input conditions from Traffic Supervision.
- Software shall be capable of inputting and editing attributes of the Correlated Traffic Event

Data, such as serial number, place, time and date, event types and serial number of preceding event, by Traffic Information Operator through the Data Input Device.

- Software shall be capable of correlating the Correlated Traffic Event Data with its attribution of serial number, place, time & date, event types, serial number.
- Software shall be capable of defining and categorizing event types such as traffic accident, breakdown vehicle, left obstacle, driving in the reverse direction, congestion, vandalism, significant weather, natural disaster, traffic regulation, and others. The outlines of individual events are defined below.
  - Traffic accident means property damage accidents, injury or death caused by accident, and multiple impact accident.
  - Vehicle breakdown means tire puncture, out of gas, engine failure or car fire.
  - Left obstacle means clutter on road such as cargo, corrugated board, lumber, vehicle part, oil or liquid.
  - Congestion condition means identified congestion result of traffic analysis.
  - Vandalism means road damage caused by vandals.
  - Bad weather means strong wind, thick fog, or heavy rainfall.
  - Natural disaster means disasters caused by earthquake, flood, roadside fire, falling rock, landslide, power failure, or lightning strike, etc.
  - Traffic regulation means closure, in-coming restriction, speed restriction or lane restriction.
- Software shall be capable of defining the place of event by road section and kilometre signpost.
- Software shall be capable of defining the time and date of the event by year, month, date, hour, minute.
- Software shall be capable of running the backup of Data Server at a time and date which are set up in advance.
- Software shall be capable of retrieving the Correlated Traffic Event Data that is stored in Data Server by place and time and shall be capable of printing out the results of retrieval.
- The Data Server shall have storage capacity to store all data on traffic event data.
- The Data server shall be capable of executing backup of the stored data in the data server on the date which is set up in advance.
- The Data server shall be capable of executing the restoration of backup data.
- The Data Server shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).

6.4 Human Machine Interface

- Software shall have human machine interface to display categorized Correlated Traffic Event Data by its attribution of place or time on the screen.
- Software shall have human machine interface for the operator to input the necessary

commands.

- The system shall have two or more display terminals.
- The traffic data server shall be capable of management by remote control.

6.5 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

6.6 Installation

- Software shall be capable of being installed on the operating system such as Windows or Linux which is widely available in many countries.
- The Traffic Event Data Server shall have database system such as Oracle or MySQL or etc.
- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Traffic Event Data Server shall be installed in air conditioned room in Regional Main Center.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of

lightning protection system and other grounding facilities installed within short distance

- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

7. Traffic Event Data Server (Prioritization for Data Dissemination)

7.1 Functions

- Software shall be capable of prioritizing and categorizing Correlated Traffic Event Data.
- Software shall be capable of generating and categorizing message data to indicate VMS and SGM based on the prioritized Correlated Traffic Event Data.

7.2 Structure

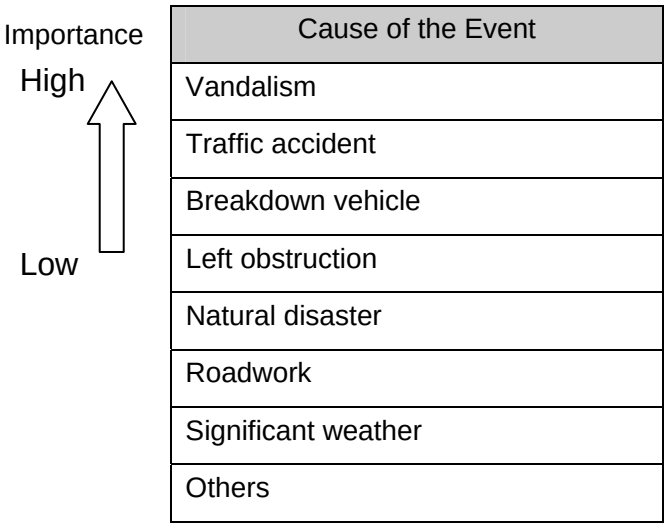
- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The Traffic Event Data Server (Prioritization for Data Dissemination) shall have sufficient durability for 24hours a day, 365 days a year.
- The Traffic Event Data Server (Prioritization for Data Dissemination) shall have the structure which is possible to fix in the building in Regional Main Center.
- The structure of Traffic Event Data Server (Prioritization for Data Dissemination) shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Traffic Event Data Server (Priolitization for Data Dissemination) shall be capable to implement the periodical checking and clean up activities.

7.3 Performance

- Software shall be capable of prioritizing information on traffic events to be disseminated by the importance and the place of the event occurrence.
- Software shall be capable of determining prioritizing traffic events based on the importance and cause of the event information to be disseminated.

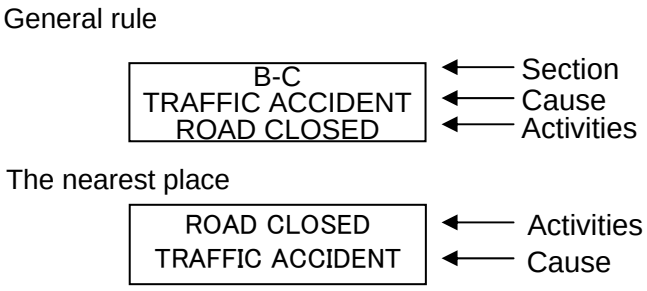
- Importance of the event information to be disseminated shall be defined in the order of closure, in-coming restriction, congestion, lane restriction, speed restriction, and others.
- Importance of the cause of the event shall be defined in the order of vandalism, traffic accident, breakdown vehicle, left obstacle, natural disaster, construction work, significant weather, and others.

Figure 7.1 Importance of the Cause of the Event



- Software shall be capable to determining prioritization of event information to be disseminated based on the information of the place of the event.
  - If several events, having the same priority level, occur in similar area, the latest information within the nearest event of the VMS shall be given higher priority to be disseminated.
  - If several events having the same priority level occur at the same kilometre post on the same section of the expressway, the latest event information shall be given higher priority.
  - As for disseminating Information at upstream side of diversion point of junction, the event information where route traffic volume is higher than others shall be given higher priority.
- Software shall be capable of generating messages to be disseminated automatically based on the basic message template of either characters or figures defined in advance by individual VMS and SGM.
- Message of the event shall be displayed in the order of: “section or point”, “cause or phenomena”, and “activities or response”. For emergency cases such as closure of the expressway, the latest message shall be displayed in the order of: “activities or response”, and “cause or phenomena”.

Figure 7.2 Order of Displayed Message



- Message to be disseminated on VMS shall be capable of being displayed in Vietnamese and English except for the geographic name.
- Software shall be capable of inputting and editing message data by the Data Input Device.
- Software shall be capable of running the backup of Data Server at the scheduled time and date.
- Software shall be capable of retrieving the message data that is stored in Data Server by place and time and shall be capable of printing out results of retrieval.

7.4 Human Machine Interface

- Software shall have human machine interface to display each message's position and time on the screen.
- Software shall have the human machine interface for the operator to input the necessary commands.
- The traffic event data server shall be capable of management by remote control.

7.5 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

7.6 Installation

- Software shall be capable of being installed on the operating system which is widely available in many countries such as Windows or Linux.
- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Traffic Event Data Server shall be installed in air conditioned room in Regional Main Center.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

8. Traffic Event Data Server (Data Storage for Management Office)

8.1 Functions

- Software shall be capable of storing the transmitted traffic event data and message data from Main Center and shall be capable of displaying it on the monitor screen.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The Traffic Event Data Server (Data Strage for Management Office) shall have sufficient durability for 24hours a day, 365 days a year.
- The Traffic Event Data Server (Data Strage for Management Office) shall have the structure which is possible to fix in the building in Regional Main Center.
- The structure of Traffic Event Data Server (Data Strage for Management Office) shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Traffic Event Data Server (Data Strage for Management Office) shall be capable to implement the periodical checking and clean up activities.

8.3 Performance

- Software shall be capable of storing the transmitted traffic event data and message data from Traffic Event Data Server at Main Center and shall be capable of compiling it in a database.
- Software shall be capable of running the backup of Data Server at the scheduled time and date.
- Software shall be capable of inputting and editing message data by the Data Input Device.
- Software shall be capable of running the backup of Data Server at the scheduled time and date.
- Software shall be capable of retrieving the message data that is stored in Data Server by place and time and shall be capable of printing out results of retrieval.

8.4 Human Machine Interface

- Software shall have human machine interface for the operator to display traffic event data and message data on the screen and to print it out.
- Software shall have human machine interface to display each message's position and time on the screen.
- The traffic event data server shall be capable of management by remote control.

8.5 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

8.6 Installation

- Software shall be capable of being installed on the operating system such as Windows or Linux which is widely available in many countries.
- The Traffic Event Data Server shall have database system such as Oracle or MySQL or etc.
- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Traffic Event Data Server shall be installed in air conditioned room in Regional Main Center.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.

- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

9. Traffic Event Data Monitor

9.1 Functions

- The equipment component shall be capable of displaying the stored traffic event data and message data in Data Server on the monitor.

9.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The Traffic Event Data Monitor shall have sufficient durability for 24hours a day, 365 days a year.
- The Traffic Event Data Monitor shall have the structure which is possible to fix in the building in Regional Main Center.
- The structure of Traffic Event Data Monitor shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Traffic Event Data Monitor shall be capable to implement the periodical checking and clean up activities.

9.3 Performance

- Recommended size of the equipment component shall be 20 inches or more to check the stored traffic event data and message data in Data Server on the monitor.
- Recommended resolution of the equipment component shall be 1920x1080 dpi or more.

9.4 Human Machine Interface

- Software shall have human machine interface to display each message's position and time on the screen.

9.5 Communication Interface

- The system shall be capable of transmitting the all data and signals over TCP/IP.
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

9.6 Installation

- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Traffic Event Data Monitor shall be installed in air conditioned room in Regional Main Center.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

10. Ambient Conditions

- The equipment component shall be installed in the office and shall be protected with measures against interferences of other electronic devices.
- The equipment component shall be capable of operating normally in the ambient conditions of temperature 25 +/- 3 degrees C in average with relative humidity between 20 and 80 %.
- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Main Center and the Road Management Office.

11. Power Supply

- The nominal characteristics of the main supply are AC 220 volts single phase and 50 Hz frequency. For stable supply of power, the subsystem requires to install UPS (Uninterruptible Power Supply Unit), which accommodates a surge or voltage variation that may occur on the main power supply.

12. Maintainability

- The system shall be capable of doing maintenance and inspection easily and simply.

13. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit a copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

14. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions:

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least the inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation:

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant

3) Necessary Documents

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including followings;

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission document

(8)
Traffic Supervision

1. General Outline

This functional package allows the road operators at the Main Center and road management office to supervise totally and visually the current traffic conditions on the expressways and the information organized as traffic events

2. Scope

Draft General Specifications deal with the equipment components and software to be installed in the Main Centers of the expressway network for activating functional packages.

3. Relevant Regulations and Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries

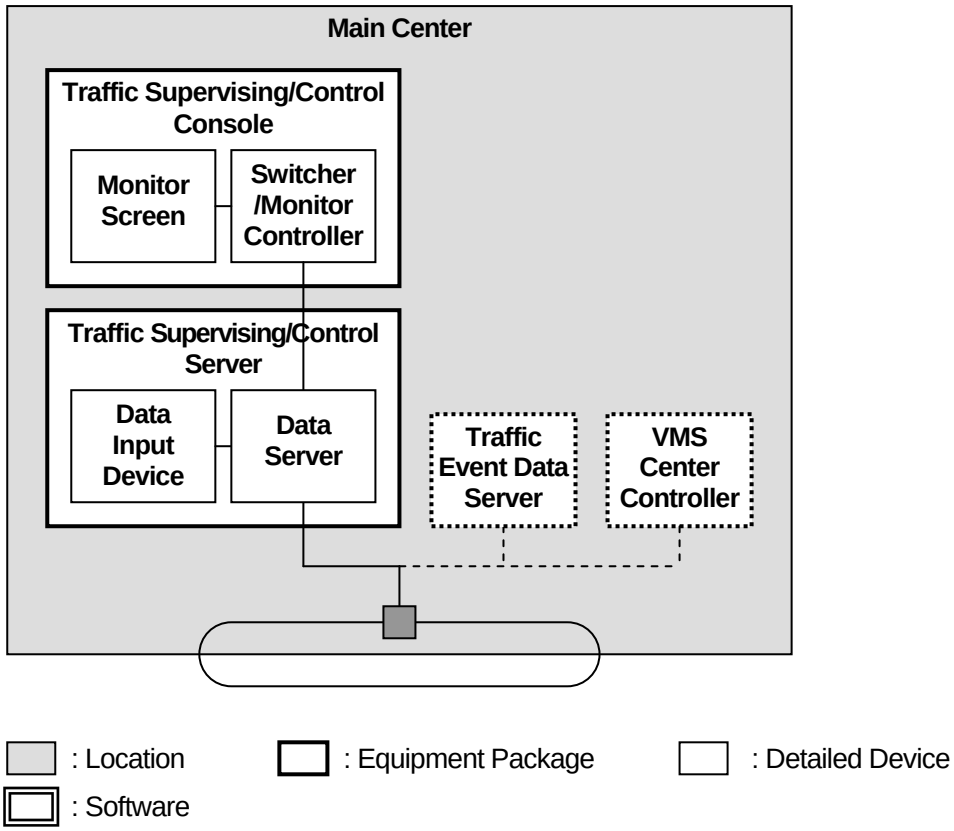
4. Requirements

- System shall be capable of allowing inputting the data necessary for generating/managing information for traffic control.
- System shall be capable of indicating the road network that is object of operation and management by the road operator.
- System shall be capable of indicating the information categorized as traffic events, with specific time and place of their occurrences, for the operators in the Main Center and road management office.
- System shall be capable of functioning 24 hours a day, 365 days a year by a redundant system and sufficient durability/reliability of equipment components.

5. System Architecture

System architecture for traffic supervision is shown below.

Figure 5.1 System Architecture for Traffic Supervision



: Location : Equipment Package : Detailed Device

: Software

Broken Lines: Outside of This Functional Package

6. Traffic Supervising/Control Server

6.1 Functions

- Software shall be capable of showing the total expressway network on the combined display, and shall be capable of displaying all toll gates and interchanges on the displayed expressways corresponding to their location. VMS, SGM, and CSS also shall be displayed on the expressways corresponding to their location on the combined screen, with function of displaying the disseminating information.
- Software shall be capable of sectionalizing the expressways by Minimum Expressway Management Section (hereinafter referred to as “MEMS”) which means between adjacent interchanges and between adjacent interchange and tollgate to be installed at least one VMS/CSS so as to be displayed in different colour for each MEMS on the combined screen.
- Software shall be capable of converting the data for displaying on the combined screen visually into the traffic event data and the message data that is stored in the Traffic Event Data Server.
- Software shall allow intervening in the traffic event data and the message data that is stored in the Traffic Event Data Server by Traffic Info Operator.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

6.2 Structure

- The equipment components shall be installed in the office having sufficient working space.
- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning, rust and dust.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The Traffic Supervising/Control Server shall have sufficient durability for 24hours a day, 365 days a year.
- The Traffic Supervising/Control Server shall have the structure which is possible to fix in the building in Regional Main Center.

- The structure of Traffic Supervising/Control Server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Traffic Supervising/Control Server shall be capable to implement the periodical checking and clean up activities.

6.3 Performance

- Software shall be capable of converting the traffic event data to event position data for the event occurrence position of the expressways, which will be displayed based on the coordinates on the combined screens, and also automatically converting it to colour data indicating traffic event types. The traffic event data is stored in the Traffic Event Data Server, and in order to convert it when the event is detected, the software shall be capable of retrieving it from the Traffic Event Data Server and capable of displaying it on the combined display.
- Software shall be capable of converting the message data, which is stored in the Traffic Event Data Server, to the colour data indicating the disseminating status of the message of the corresponding VMS described on the combined screen.
- Software shall be capable of correlating different several traffic events' data on the combined screens by mouse operation or selection of pulldown menu to be developed with hierarchical structure.
- Software shall be capable of pointing and selecting the specific VMS described on the combined screen by mouse operation, and capable of selecting the providing message by selection of pulldown menu to be developed with hierarchical structure.
- Software shall be capable of inputting and editing the attributes of traffic event data such as event type, place, time, message disseminating place, disseminating message contents by the Traffic Information Operator by the Data Input Device. Edited data by Traffic Information Operator shall be capable of being stored into Traffic Event Data Server.
- The Data Server shall have storage capacity to store all data on traffic event data.
- The Data server shall be capable of executing backup of the stored data in the data server on the date which is set up in advance.
- The Data server shall be capable of executing the restoration of backup data.
- The Data Server shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).
- The equipment shall be capable of control all of display units like one display.
- The equipment shall be capable of display all of traffic management information such as CCTV images, traffic information, weather information, VMS information and so on.

6.4 Human Machine Interface

- Software shall have human machine interface to display categorized Correlated Traffic Event Data by its attribution of place or time on the screen.
- The traffic data server shall be capable of management by remote control.
- The display unit shall have the input terminals, such as Mini D-sub 15-pin, HDMI, RS-232C D-sub 9-pin and LAN port.
- The display unit shall have the output terminals, such as RCA pin (L/R), RS-232C D-sub 9-pin and LAN port.

6.5 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

6.6 Installation

- The equipment of components shall be installed at each Regional Main Center.
- Software shall be capable of being installed on the operating system such as Windows or Linux which is widely available in many countries.
- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Traffic Supervising/Control Server shall be installed in air conditioned room in Regional Main Center.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the

relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.

- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

7. Traffic Supervising/Control Console

7.1 Functions

- The equipment components shall be capable of displaying the traffic event data on the integrated display with its related attributes.
- The equipment components shall be capable of indicating other traffic event data as options which seem to be connected, for the Traffic Information Operator to make correlation among them.
- The equipment components shall be capable of displaying the required menu on the combined screen, and capable of selecting proper disseminating information option by Traffic Information Operator among menu alternatives by mouse operation in order to disseminate it through VMS, SGM, and CSS.
- The equipment components shall be capable of returning to the original displaying conditions after traffic event is cleared.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning, rust and dust.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The Traffic Supervising/Control Console shall have sufficient durability for 24hours a day, 365 days a year.
- The Traffic Supervising/Control Console shall have the structure which is possible to fix in the building in Regional Main Center.

- The structure of Traffic Supervising/Control Console shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Traffic Supervising/Control Console shall be capable to implement the periodical checking and clean up activities.

7.3 Performance

- The equipment shall be capable of combining several displays into one large screen display to make 300 inchs or more. The unit display size shall be 60 inches or more.
- The borders between neighboring display units are a virtually seamless, less than 10.0 mm wide.
- The resolution of display unit shall be greater than 1280 x 720 pixels.
- The dimension of display unit, the depth must be less than 500 mm.
- The viewing angle of display unit must be more than 170 degrees in horizontally, 170 degrees in vertically.
- The maximum brightness of display unit must be greater than 500 cd/m2
- The contrast ratio of display unit must be greater than 2000:1.
- The display unit must be consumed power less than 500W
- The display unit shall be capable attach on a wall by using the equipments which is distributed from supplier.
- The display unit shall have the input terminals, such as Mini D-sub 15-pin, HDMI, RS-232C D-sub 9-pin and LAN port.
- The display unit shall have the output terminals, such as RCA pin (L/R), RS-232C D-sub 9-pin and LAN port.
- The equipment shall be capable of combining several displays into one large screen display. The unit display size shall be 60 inches or more.

Figure 8.1 Image of combined large Screen

60inches or more	60inches or more	60inches or more	60inches or more
60inches or more	60inches or more	60inches or more	60inches or more
60inches or more	60inches or more	60inches or more	60inches or more

- The equipment shall be capable of switching to show images in rotation.
- The equipment shall be capable of showing a locked image that is selected by the

Traffic Info Operator.

7.4 Human Machine Interface

- The equipment shall have human machine interface for the Traffic Info Operator to input the necessary commands.
- Software shall have human machine interface to display each message's position and time on the screen.
- The display unit shall have the output terminals, such as Mini D-sub 15-pin, HDMI, RS-232C D-sub 9-pin and LAN port.
- The display unit shall have the input terminals, such as RCA pin (L/R), RS-232C D-sub 9-pin and LAN port.

7.5 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here..

7.6 Installation

- The equipment of components shall be installed at each Regional Main Center.
- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Traffic Supervising/Control Console shall be installed in air conditioned room in Regional Main Center.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning

protection system and other grounding facilities installed within short distance

- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

8. Ambient Conditions

- The equipment component shall be installed in the office and protected from interferences of other electronic devices.
- The equipment component shall be capable of operating normally in the ambient conditions of temperature 25 +/- 3 degrees C in average with relative humidity between 20 and 80 % in average.
- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Main Center.

9. Power Supply

- The nominal characteristics of the main supply are AC 220 volts single phase and 50 Hz frequency. For stable supply of power, the subsystem requires to install UPS (Uninterruptible Power Supply Unit), which accommodates surge or voltage variation that may occur on the main power supply.

10. Maintainability

- The equipment components shall be capable of being maintained easily and simply

11. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit a copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

12. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions;

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least the inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant.

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant.

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant.

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including followings;

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission document

(9)
VMS Indication

1. General Outline

This functional package allows the road operators to provide road users on the expressways with the information on traffic events by using VMS (Variable Message Sign) installed in front of entrances, exits, tollgates, junctions and tunnels.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, and in the Main Centers of the expressway network for activating functional packages.

3. Relevant Regulations and Standards

1) International Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- IEC 60529: Degrees of Protection provided by Enclosure (IP Code)

2) National Standards

- 22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC (Documents on message/signs for highways)
- 22TCN237-01 Regulation on Road Signs
- TCVN 4054
- TCVN 5729
- TCVN 2737:1995

4. Requirements

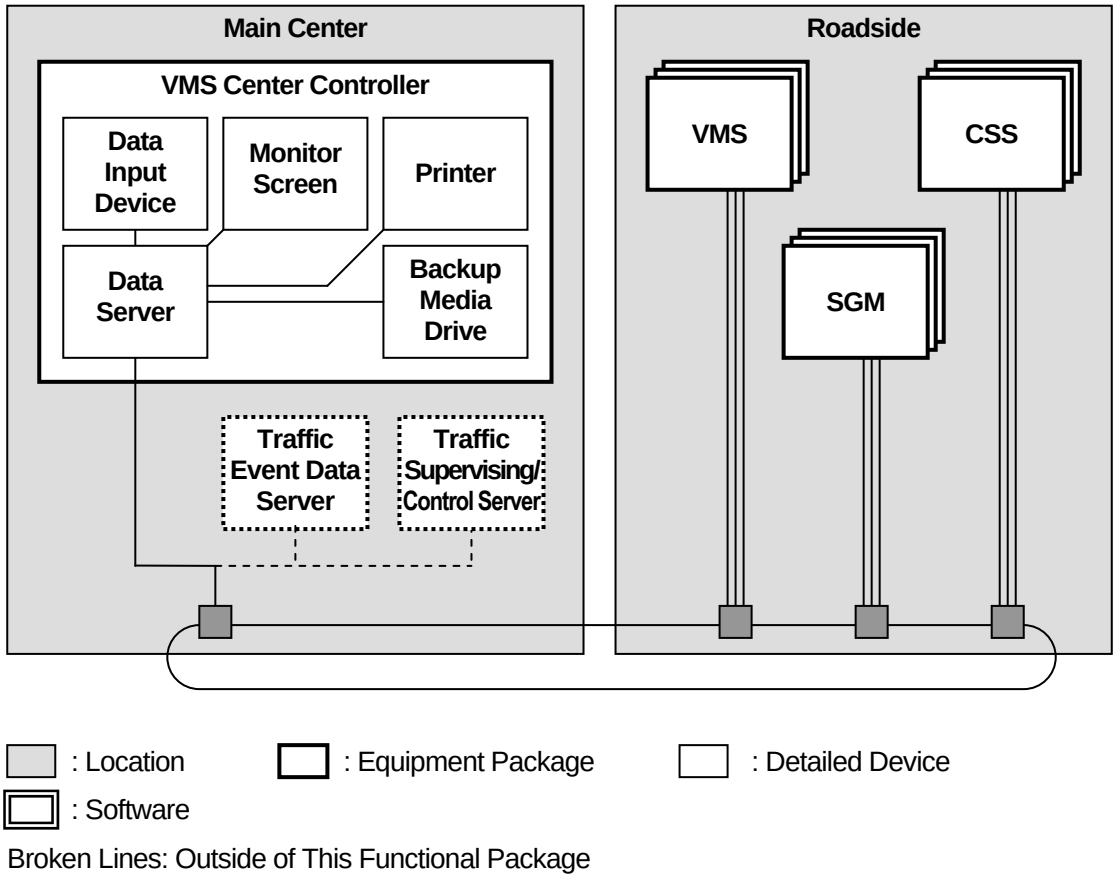
- System shall be capable of disseminating information in the form of traffic events which includes traffic accidents, reverse driving, broken-down vehicle, left obstacle, natural disaster, vandalism, construction work, bad weather, congestion and traffic restriction.
- System shall be capable of providing information according to the priority by the distances and the traffic volume to the sites of generated traffic events.

- System shall be capable of indicating information in Vietnamese and English.
- System shall be capable of indicating text information for the drivers to read in their vehicles at the maximum speed 120 km/h.
- System shall be capable of updating the indicated information every 5 minutes.
- System shall be capable of indicating and printout the needed results.
- System shall be capable of allowing installing roadside equipment in front of interchanges, entrances, exits, tollgates, junctions and tunnels on the expressways.
- System shall be capable of allowing securing sufficient durability and reliability of equipment components in the ambient conditions at installation site on roadside.

5. System Architecture

System architecture for VMS indication is shown below.

Figure 5.1 System Architecture for VMS Indication



6. VMS (Variable Message Sign)

6.1 Functions

- To disseminating information, generated from VMS Indication Data Set (such as breakdown of vehicle, traffic accidents, left obstacles, natural disasters, rainfall, strong wind, fog and other occurrences) which are transmitted from “Traffic Event Data Server”.
- To operate continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically display the information disseminated prior to the power failure.
- The system shall be capable of display in full-colour.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment components are installed outdoors.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow performing maintenance works from the its side and back, but not from lane direction, in order to minimize the influence to traffic activities.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with the measures against interference from other electronic devices.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.

6.3 Performance

- The height of displayed letters shall be 450 mm more.
- The width of displayed letter shall be 16-86% of letter height (ie, 72-387 mm). It is accordance to 22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC (Message/Signs for Highways)

- The line thickness of the displayed letter shall be 10-20% of letter height (ie, 45-80 mm). It is accordance to 22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC (Message/Signs for Highways)
- One displayed row shall not have more than 24 letters.
- LED shall be used for displaying panel, concerning its durability and light intensity.
- The equipment components shall be capable of displaying in Vietnamese and English languages.
- Display font shall be in accordance with 22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC (Documents on Message/Signs on Highways).
- System is capable of control of display from VMS Centre Controller.
- The equipment components shall have control signal input interface for trial display when setting up at installation site.
- The equipment components shall have interface for inputting display information directly to VMS in case of emergency.
- The equipment components shall be capable of visual performance with bias angle of +/- 10 degrees from the perpendicular to display panel.
- When displaying letters, the letters shall shift left-right, and top-bottom, 2dots for each shifting time, at certain time interval equal with lighting frequency of LED elements. Picture display is an exception.
- Dot intervals of LED elements shall be less than 16 mm.
- The brightness of each display colour in day time as follows,

  Blue 500cd/㎡ or more,

  Red 1600cd/㎡ or more

  Green 2200cd/㎡ or more

  White 4300cd/㎡ or more

  Yellow 3800cd/㎡ or more

  Cyan 2700cd/㎡ or more

  Orange 2500cd/㎡ or more

- The brightness of each display colour in night time as follows,

  Blue 25cd/㎡ or more

  Red 85cd/㎡ or more

  Green 120cd/㎡ or more

  White 230cd/㎡ or more

  Yellow 205cd/㎡ or more

Cyan 145cd/㎡ or more

Orange 125cd/㎡ or more

- The displaying panel shall be capable of displaying the disseminated information within 3.0 seconds after receiving control signal from VMS Center Controller.
- In case of the disseminated information be change and repeat, the display shall be capable of being switched in less than 0.5 seconds, and of displaying each information message during 1 to 10 seconds, the time capable be changed by operation from Regional Main Center.
- Base colour of the displaying panel shall be mat black.
- The equipment component shall be selected for procurement based on availability of the Device Driver for controlling display of the equipment component. The equipment component shall be supported from interface of "VMS Center Controller", if possible.
- There are three types of VMS, Type-A, Type-B, Type-C. These type of VMS is choosen depend on the location. The location is decided from the consideration of what is disseminating by using the VMS.
- The specification of each type of VMS as follows,

Type-A:

Location : In front of the entrance

Specification:

- Display type: full-colour LED
- Number of rows : 3 rows
- Number of columns : 24 columns/row
- Letter Height : 450mm
- LED Colour: Red, Blue, Light green
- LED dot pitch: 16mm or less
- Resolution: 89(height) x 623(width) dots (55,477 dots or more)
- Weght : 1,148kg or less

Type-B:

Location : In front of the exit

Specification:

- Display type: full-colour LED
- Number of rows : 2 rows
- Number of columns : 24 columns/row
- Letter Height : 450mm

- LED Colour: Red, Blue, Light green
- LED dot pitch: 16mm or less
- Resolution: 59(height) x 623(width) dots (36,757 dots or more)
- Weght : 765kg or less

Type-C:

Location : In front of exits on RR3, and In front of entrance on narrow streets

Specification:

- Display type: full-colour LED
- Number of rows : 3 rows
- Number of columns : 14 columns/row
- Letter Height : 450mm
- LED Colour: Red, Blue, Light green
- LED dot pitch: 16mm or less
- Resolution: 89(height) x 363(width) dots (32,307 dots or more)
- Weght : 669kg or less

6.4 Human Machine Interface

- VMS shall indicate information in Vietnamese letter with height of 450 mm more.
- VMS shall have the function to indicate the information with 24 Vietnamese syllabled in one line so that the driver who drives a vehicle with 120 km/hour on the through lanes may recognize indicated contents during day and night.
- VMS shall have the function to indicate the information with 24 Vietnamese syllabled in one line so that the driver who drives a vehicle with 60 km/hour before the entrance of expressways may recognize indicated contents during day and night.
- VMS shall have the function to indicate the information with 24 Vietnamese syllabled in one line so that the driver who drives a vehicle with 120 km/hour before the exit ramp of expressways may recognize indicated contents during day and night.
- The system shall have a human-machine interface for Traffic Information Operator to input the “VMS Indication Data Set”.
- The system shall have the function to directly input the displayed information from VMS Center Controller at Regional Main Center and Road Management Office, irrespective of Traffic Event Data.
- The VMS which is inputed the information directly, it shall be capable disengagement from under control respective of Traffic Event Data, according to operation from Road Management Center.

- The system shall have a control signal input interface to directly control the displayed information on VMS at the installation site when communication line interruption occurs.

6.5 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The system shall be capable of controlling LED device light to be on or off after getting control signal from VMS Center Controller.
- Transmission devices shall have following interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the interface standards
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

6.6 Installation

- VMS shall be installed at the toll gates on the through lane.
- VMS shall indicate the information in 24 Vietnamese syllabled on the through lanes for drivers who drives a vehicle with 60 km/hr during day or night may .
- VMS shall indicate the information in 24 Vietnamese syllabled before the entrance of expressways for drivers who drives a vehicle with 60 km/hr during day or night may .
- VMS shall indicate the information in 24 Vietnamese syllabled before the exit ramp of expressways for drivers who drive 120 km/hr during day or night.
- VMS shall be installed so that they may not obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- VMS shall be installed on stable structures with sufficient strength so that direction of indication shall not be changed by strong wind.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.
- VMS Type-A is located at less than 100m before the entrance of expressways to the extent possible.
- VMS Type-B is located at approximately 200m before the exit ramp of expressways to the extent possible.

- The location shall be consideration about difficulty level of construction, cost of construction, viewability of VMS.
- VMS Type-C is choosen according to the site conditions, such as the procuring of site is difficult, difficulty level of construction, cost of construction.
- In case the equipments to be located at outdoor, the screw for attachment should be antitheft type.

7. CSS (Changeable Speed Limit Sign)

7.1 Functions

- The system shall be capable of operating 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from power failure, the system shall be capable of automatically displaying the information disseminated prior to the power failure.
- The system shall be capable of display in mono-colour.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment component shall be installed outdoors.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow performing maintenance works from the it's side and back, but not from lane direction, in order to minimize the influence to traffic activities.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with the measures against interference from other electronic devices.
- Dimension of CSS shall follow Vietnamese Standards on 22TCN237-01 Regulation on Road Signs.
- Diameter of CSS shall be 122.5 cm.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.

7.3 Performance

- The height of displayed letters shall be 450 mm.
- The width of displayed letter shall be 24-72% of letter height (ie, 108-324 mm). It is accordance to 22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC (Message/Signs for Highways)
- The line thickness of the displayed letter shall be 10-20% of letter height (ie, 45-80 mm). It is accordance to 22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC (Message/Signs for Highways)
- LED shall be used for display panel, considering its durability and light intensity.
- Dimension of CSS shall be refered according to Vietnamese Standards on 22TCN237-01 Regulation on Road Sign.
- The specification of each type of VMS as follows,
  - Display type: full-colour LED
  - Shape of CSS : 1,225mm phi
  - Letter Height : 450mm
  - LED Colour: Red, Blue, Light green
  - LED dot pitch: less than 16mm
  - Resolution: 4,600 dots more
  - Weight : less than 71kg
- The system shall have control signal input interface for display trial when positioning CSS.
- The equipment components shall be capable of having visual performance with bias angle of +/-10 degrees from the perpendicular to display panel.
- Dot intervals of LED elements shall be less than 16 mm.
- The brightness of each display colour in day time as follows,

  Blue 500cd/㎡ or more,

  Red 1600cd/㎡ or more

  Green 2200cd/㎡ or more

  White 4300cd/㎡ or more

  Yellow 3800cd/㎡ or more

  Cyan 2700cd/㎡ or more

  Orange 2500cd/㎡ or more
- The brightness of each display colour in night time as follows,

  Blue 25cd/㎡ or more

Red 85cd/㎡ or more

Green 120cd/㎡ or more

White 230cd/㎡ or more

Yellow 205cd/㎡ or more

Cyan 145cd/㎡ or more

Orange 125cd/㎡ or more

- The displaying panel shall be capable of displaying the disseminated information within 3.0 seconds after receiving control signal from VMS Center Controller.
- Base colour of the displaying panel shall be mat black.
- The equipment component shall be selected for procurement based on availability of supplying the Device Driver for controlling display of the equipment component. The equipment component shall be supported from interface of "VMS Center Controller", if possible.

7.4 Human Machine Interface

- CSS shall indicate information in letter height of 450 mm or more, and CSS shall have the function to indicate the speed limit so that the driver who drives a vehicle with 60 km/hour on the through lanes may recognize indicated figures during day and night.
- The system shall have a human-machine interface for Traffic Information Operator to input the "VMS Indication Data Set".
- The system shall have a control signal input interface to directly control the displayed information on VMS at the installation site when communication line interruption occurs.

7.5 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The system shall be capable of controlling LED device light to be on or off after getting control signal from VMS Center Controller.
- Transmission devices shall have following interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the interface standards
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

7.6 Installation

- CSS shall be installed on stable structures with sufficient strength so that direction of indication may not be changed by strong wind.
- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.
- CSS shall be installed at arroud merging point on through way and intervals of 5 km or less.
- Software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- In case the equipments to be located at outdoor, the screw for attachment should be antitheft type.

8. SGM (Simple Graphical Message sign)

8.1 Functions

- To disseminating information, generated from VMS Indication Data Set (such as breakdown of vehicle, traffic accidents, left obstacles, natural disasters, rainfall, strong wind, fog and other occurrences) which are transmitted from “Traffic Event Data Server”.
- To operate continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically display the information disseminated prior to the power failure.
- The system shall be capable of display in full-colour.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment components are installed outdoors.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow performing maintenance works from the its side and back, but not from lane direction, in order to minimize the influence to traffic activities.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with the measures against interference from other electronic devices.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.

8.3 Performance

- The height of displayed letters shall be 450 mm more.
- The width of displayed letter shall be 16-86% of letter height (ie, 72-387 mm). It is accordance to 22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC (Message/Signs for Highways)

- The line thickness of the displayed letter shall be 10-20% of letter height (ie, 45-80 mm). It is accordance to 22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC (Message/Signs for Highways)
- One displayed row shall not have more than 24 letters.
- LED shall be used for displaying panel, concerning its durability and light intensity.
- The equipment components shall be capable of displaying in Vietnamese and English languages.
- Display font shall be in accordance with 22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC (Documents on Message/Signs on Highways).
- System is capable of control of display from VMS Centre Controller.
- The equipment components shall have control signal input interface for trial display when setting up at installation site.
- The equipment components shall have interface for inputting display information directly to VMS in case of emergency.
- The equipment components shall be capable of visual performance with bias angle of +/- 10 degrees from the perpendicular to display panel.
- When displaying letters, the letters shall shift left-right, and top-bottom, 2dots for each shifting time, at certain time interval equal with lighting frequency of LED elements. Picture display is an exception.
- Dot intervals of LED elements shall be less than 16 mm.
- The brightness of each display colour in day time as follows,

  Blue 500cd/㎡ or more,

  Red 1600cd/㎡ or more

  Green 2200cd/㎡ or more

  White 4300cd/㎡ or more

  Yellow 3800cd/㎡ or more

  Cyan 2700cd/㎡ or more

  Orange 2500cd/㎡ or more

- The brightness of each display colour in night time as follows,

  Blue 25cd/㎡ or more

  Red 85cd/㎡ or more

  Green 120cd/㎡ or more

  White 230cd/㎡ or more

  Yellow 205cd/㎡ or more

Cyan 145cd/㎡ or more

Orange 125cd/㎡ or more

- The displaying panel shall be capable of displaying the disseminated information within 3.0 seconds after receiving control signal from VMS Center Controller.
- In case of the disseminated information be change and repeat, the display shall be capable of being switched in less than 0.5 seconds, and of displaying each information message during 1 to 10 seconds, the time capable be changed by operation from Regional Main Center.
- Base colour of the displaying panel shall be mat black.
- The equipment component shall be selected for procurement based on availability of the Device Driver for controlling display of the equipment component. The equipment component shall be supported from interface of "VMS Center Controller", if possible.

8.4 Human Machine Interface

- VMS shall indicate information in Vietnamese letter with height of 450 mm more.
- VMS shall have the function to indicate the information with 24 Vietnamese syllabled in one line so that the driver who drives a vehicle with 120 km/hour on the through lanes may recognize indicated contents during day and night.
- The system shall have a human-machine interface for Traffic Information Operator to input the "VMS Indication Data Set".
- The system shall have the function to directly input the displayed information from VMS Center Controller at Regional Main Center and Road Management Office, irrespective of Traffic Event Data.
- The VMS which is inputed the information directly, it shall be capable disengagement from under control respective of Traffic Event Data, according to operation from Road Management Center.
- The system shall have a control signal input interface to directly control the displayed information on VMS at the installation site when communication line interruption occurs.

8.5 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The system shall be capable of controlling LED device light to be on or off after getting control signal from VMS Center Controller.
- Transmission devices shall have following interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure

- Data transmission procedure
- Timing chart and other details of the interface standards

- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

8.6 Installation

- VMS shall be installed at the toll gates on the through lane.
- VMS shall indicate the information in 24 Vietnamese syllabled before the exit ramp of expressways for drivers who drive 120 km/hr during day or night.
- VMS shall be installed so that they may not obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- VMS shall be installed on stable structures with sufficient strength so that direction of indication shall not be changed by strong wind.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.
- In case the equipments to be located at outdoor, the screw for attachment should be antitheft type.

9. VMS Center Controller

9.1 Functions

- The system shall be capable of acquiring the information currently displayed on VMS and CSS.
- The system shall be capable of allowing operating staff to make decision on information to be disseminated on VMS and CSS, based on the current displayed information and Traffic Event Data Set.
- The system shall be capable of synchronizing its clock to the clock of “Traffic Supervising / Control Server” at the start-up.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The system shall be capable of generating a letter strings to be displayed on VMS based on the following information, which is received from “Traffic Event Data Server”.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The system shall be capable of generating a letter string to be displayed on VMS, based on the following information which is input from “Data Input Device” of “VMS Data Controller”.
- The system shall be capable of generating a letter string to be displayed on CSS, based on the following information which is sent from “Traffic Event Data Server”.
- The system shall be capable of generating a letter string to be displayed on CSS, based on the following information which is input from “Data Input Device” of “VMS Data Controller”.

9.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment components shall be installed outdoors.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall be protected with the measures against interference from other electronic devices

9.3 Performance

- The system shall be capable of sending a signal to control LED device of VMS in order to display generated letter strings on VMS.
- The system shall be capable of displaying on Monitor Screen the letter string which is being displayed on each VMS at the present moment.
- The system shall be capable of displaying on Monitor screen the list of VMS and the data which is input in each VMS at the present moment.
- The system shall be capable of printing disseminated information which is displayed on Monitor Screen.
- The system shall be capable of storing into a database letter strings which are displayed in each VMS and storing “VMS Indication Data Set” which generate letter strings.
- The system shall be capable of allowing the traffic information operator to input the ”VMS Indication Data Set” into the system.
- The system shall be capable of extracting letter strings displayed on VMS and “VMS Indication Data Set” generated from accumulated VMS database, based on searching conditions, which are input from Data Input Device, and then displaying the results on Monitor Screen.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- “Data Server” shall have disk capacity for storing data for at least one year.
- “VMS Center Controller” shall have “Backup Media Drive” for Backup of the stored data in the Data Server.
- “Data Server” shall be capable of executing the backup of the stored data on a date which is set up in advance.
- “Data Server” shall be capable of running a restoration of backup data.
- “Data Server” shall have standby spares for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).

9.4 Human Machine Interface

- The system shall have a human-machine interface for the Traffic Information Operator to input necessary commands.
- The system shall be capable of displaying generated letter string on monitor screen for confirmation.

- The system shall have two or more display terminal.
- The system shall have the function to directly input the displayed information from VMS Center Controller at Regional Main Center and Road Management Office, irrespective of Traffic Event Data.
- The VMS which is inputed the information directly, it shall be capable disengagement from under control respective of Traffic Event Data, according to operation from Road Management Center.

9.5 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The transmission devices shall have followings interfaces;
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the interface standards
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

9.6 Installation

- Software shall be capable of being installed on an operating system such as Microsoft Windows or Linux which is widely used in many countries.
- The equipment of components shall be installed at each Regional Main Centre.
- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.

10. Ambient Conditions

- The equipment component shall be installed in the offices and protected with the measures against interferences of other electronic devices.
- The equipment component shall be capable of normally operating under the following ambient conditions:

  For Main Center, Toll Management Center, and Toll Office
  Temperature: 25 +/- 3 degree C in average
  Relative humidity: between 20 and 80 % in average
  For outside
  Temperature: between - 0 and +50 degree C
  Relative humidity: below 95 %
- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Main Center.

11. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- System shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for at least 30 minutes.

12. Maintainability

- The equipment components shall be comparable of being maintained easily and simply.
- The system shall be capable to identify the faulty parts easily in case it is detected, and the replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.
- The manufacturer of the equipment components shall make a contract on technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer shall provide the necessary services based on the contract.

13. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.

- The manufacturer shall be required to submit a copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

14. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions;

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory own test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval.

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant.

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant.

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant.

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(10)
Mobile Radio Communication

1. General Outline

This functional package allows road operators to exchange information between road operation vehicles/workers on the expressway and the road management office by using radio communication.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, and in road management offices of the expressway network for activating functional packages. This Specifications deal with the equipment components and software in-vehicle and for mobile use as well.

3. Relevant Regulations and Standards

- License related to utilization of radio frequency band shall be obtained from Radio Frequency Directorate in Ministry of Information and Communication.
- Licensing fee and charge for utilization and other necessary cost shall be subject to the regulations of Radio Frequency Directorate
- Decree No. 24/2004/ND-CP dated January 14, 2004: Detailing the Implementation of a Number of Articles of the Ordinance on Post and Telecommunications Regulating Radio Frequencies
- Circular No. 36/2009/TT-BTTTT dated December 3, 2009: Stipulating Specifications and Exploiting conditions of short range Radio Frequency Devices of conditional use
- BS 7430: Earthing
- BS 6651: Lightning Protection

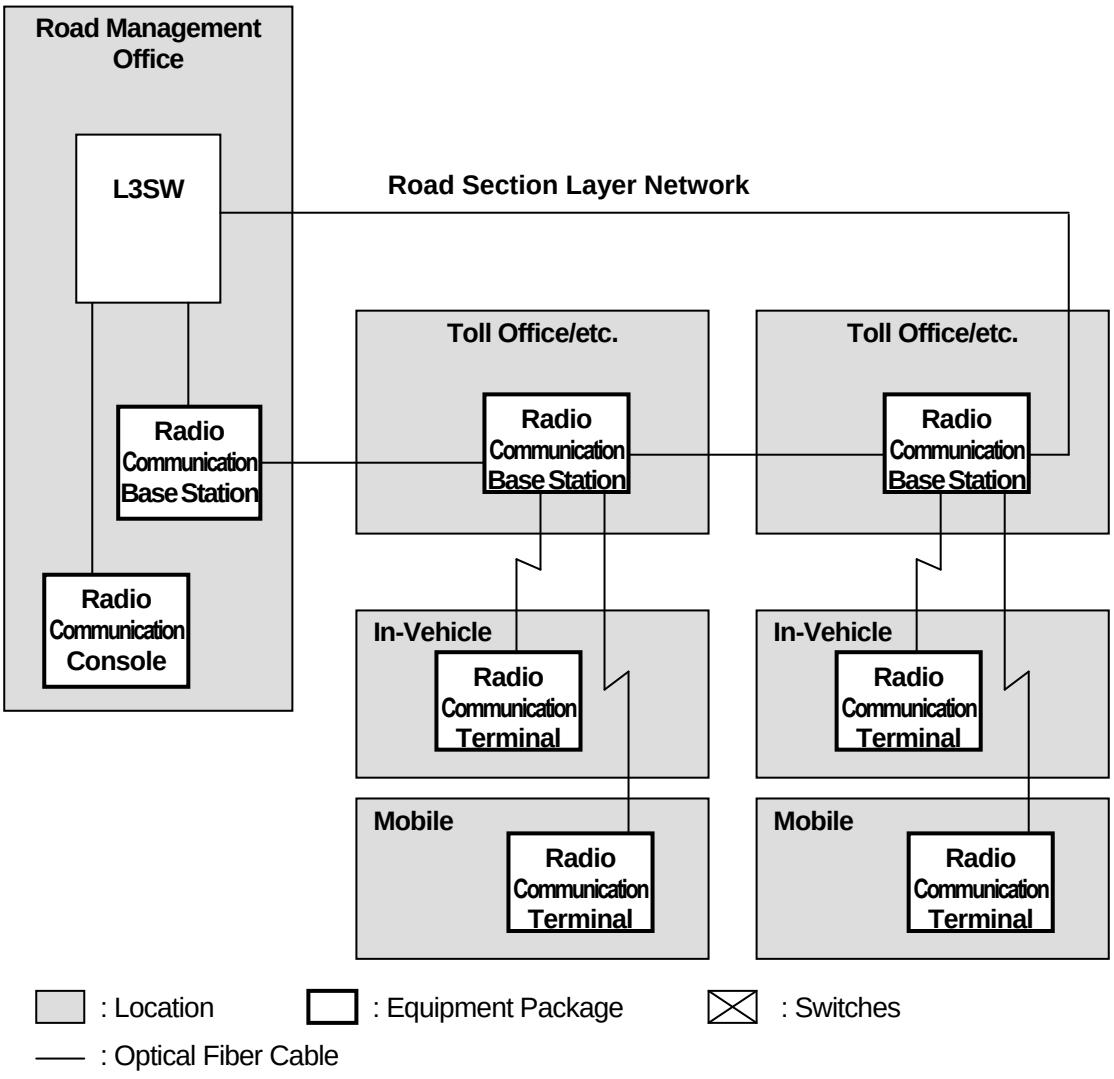
4. Requirements

- System shall be capable of promptly receiving reports of current traffic conditions on the expressways and of incidents from the operators in the toll office.
- System shall be capable of sending directives to the units concerned simultaneously for clearing incidents and enforcing traffic regulations.
- System shall be capable of operating 24 hours a day, 365 days a year with a redundant system and equipment components of sufficient durability/reliability.
- The license required for the system shall be budgeted and obtained from Radio Frequency Directorate of Ministry of Information and Communication.

5. System Architecture

System architecture for mobile radio communication is shown below.

Figure 5.1 System Architecture for Mobile Radio Communication



6. Radio Communication Base Station

6.1 Functions

- The base station shall provide interactive voice communication between Road Management Office and the terminal equipment component users who belong to the Office.
- In emergency cases when the operator in duty in Road Management Office receives directive communication from Regional Main Center, the directive communication from the operator shall be certainly transmitted to the terminal equipment component through the base station.
- The directive communication shall be capable to interrupt communication through the base station even while the terminal holder is communicating with another terminal holder within the coverage area of its own terminal.
- The radio frequency band applied shall be VHF or UHF.
- The radio communication equipment component of base station shall be prepared with backup electric power source so as to operate continuously even during commercial power failure.
- The radio communication equipment components of base station shall be types whose functions have been confirmed by the business users in foreign countries other than the original manufacturing country.
- The radio frequency and equipment components to be utilized as base station shall be licensed by Radio Frequency Directorate of Ministry of Information and Communication.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices
- The radio communication Base Station equipment component shall have sufficient durability for operating 24 hours a day, 365 days a year.
- Radio communication Base Station equipment components shall allow replacing faulty parts simply and easily when a fault is detected.

6.3 Performance

- Interference should be minimized between adjacent expressways sections managed by different road management offices.
- The coverage area for interactive voice communication using radio communication equipment component shall be 100% of the objective expressway road section including tunnel section, Interchange, service area, rest area, parking area and all other areas related to the expressway operation and maintenance.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year. During maintenance and repair period, the operation shall be continued with redundant components.

6.4 Human Machine Interfaces

- The radio communication equipment component of base station or measuring instrument to be connected to the equipment component of base station for maintenance shall have human-machine interface so that the operator can input necessary commands into the system.
- The radio communication equipment component of base station shall be capable to detect the fault of the equipment components. When the fault is detected, the system shall be capable to notify it as alert such as buzzer or flashing light on the display to the O&M staff of NMS.
- The weather data server shall be capable of management by remote control.

6.5 Communication Interfaces

- All interfaces of radio communication equipment components to be installed in a road management office area shall be compatible with each other and shall not be a hindrance to interactive voice communication.

6.6 Installation

- The Installation work shall include equipment component's unloading, customs clearance, inland/domestic transportation, equipment component installation, tower erection, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The location of Base Station and height of antenna shall be designed according to the radio frequency to be available and allowed transmitting power.
- The location of Base Station shall be selected within the premises of road management office, toll office, toll gate, interchange, or rest area, wherever possible. If the base

station is required to install outside of the premises of road management, the site ownership or agreement to utilize such land shall be clarified prior to commencement of installation work at site.

- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

7. Switching Equipment Component for Radio Communication (L3SW)

7.1 Functions

- Functions for switching equipment component for radio communication shall refer to the Switching Equipment Component in Communication System. The following are additional functions related to the Mobile Radio Communication.
- The switching equipment component for radio communication shall be capable to handle interactive voice communication between Road Management Office and the terminal equipment component users who belong to the Office.
- Directive communication from the console in Road Management Office consists of incoming calls of the terminal equipment component through the switching system.
- The switching equipment component shall be capable to select the destination of directive communication in accordance with the designation indicated by the operator of radio communication console in road management office.
- The directive communication shall be capable to interrupt communication even though the terminal user is communicating with another terminal user within the coverage area of its own terminal.

7.2 Structure

- Structure for switching equipment component for radio communication shall refer to the Switching Equipment Component in Center/Roadside Communication.

7.3 Performance

- Directive communication from the operator of console in Road Management Office shall be connected to the terminal equipment component without any connection loss.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year. During maintenance and repair period, the operation shall be continued with redundant components.
- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices

- The radio communication base station shall have the structure which is possible to fix in the building in Road Management Office and Toll Office.
- Radio communication Base Station equipment components shall allow replacing faulty parts simply and easily when a fault is detected.

7.4 Human Machine Interfaces

- Human Machine Interface for switching equipment component for radio communication shall refer to the Switching Equipment Component of Communication System.
- The weather data server shall be capable of management by remote control.

7.5 Communication Interfaces

- All interfaces between switching equipment component and other radio communication equipment components shall be compatible with each other and shall not be a hindrance to interactive voice communication.

7.6 Installation

- The Installation work shall include equipment component's unloading, customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The location of switching equipment component for Radio Communication shall be installed in air conditioned room in Road Management Office.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

8. Radio Communication Console

8.1 Functions

- In emergency cases when Road Management Office receives directive communication from Regional Main Center, the radio communication console at Road Management Office shall be capable to transmit it to the terminal equipment component.
- The radio communication console shall be capable to select terminal equipment component(s) required to transmit the directive.
- The directive communication from the radio communication console to the terminal shall be capable to interrupt communication even though the terminal user is communicating with another terminal user within the coverage area of its own terminal.
- The radio communication console equipment components shall be prepared with backup electric power source so as to operate continuously even during commercial power failure.
- The radio communication console equipment components shall be types whose functions have been confirmed by the business users in foreign countries excluding the original manufacturing country.

8.2 Structure

- The radio communication console equipment component shall have sufficient durability for operating 24 hours a day, 365 days a year.
- Radio communication console equipment components shall allow replacing faulty parts simply and easily when a fault is detected.
- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The Radio Communication Console shall have sufficient durability for 24hours a day, 365 days a year.
- The Radio Communication Console shall have the structure which is possible to fix in the building in Regional Main Center.
- The structure of the Radio Communication Console shall be capable to implement the periodical checking and clean-up activities.

8.3 Performance

- The operator shall be clearly identifiable at the destination of directive communication on the radio communication console.
- The operator shall be clearly identifiable with indicator on the radio communication console whether terminal user acknowledges the directive or not, after the operator transmits the directive.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year. During maintenance and repair period, the operation shall be continued with redundant components.

8.4 Human Machine Interfaces

- The radio communication console at road management office shall have human-machine Interfaces so that the operator can transmit directives, receive acknowledgements, and handle voice communications.
- The radio communication console at road management office shall be equipped human machine interface which is able to receive directive from the Regional Main Center.
- The Radio Communication Console shall be capable to detect the fault of the equipment components. When the fault is detected, the system shall be capable to notify it as alert such as buzzer or flashing light on the display to the O&M staff of NMS.

8.5 Communication Interfaces

- All interfaces of radio communication console equipment components to be installed in a Road Management Office shall be compatible with other connecting radio communication equipment components and shall not be a hindrance to communication.

8.6 Installation

- The Installation work shall include equipment component's unloading, customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Radio Communication Console shall be installed in Road Management Office.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- Software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely used in many countries.

- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

9. Radio Communication Terminal

9.1 Functions

- The radio communication terminal equipment component shall be equipped with directive notification alert such as buzzer for the terminal user when it receives directive communication.
- The radio communication terminal equipment component shall be equipped with response function to acknowledge a directive to the console in Road Management Office after terminal user acknowledges receiving the directive communication.
- The directive communication shall be capable to interrupt communication and transmit a directive to the terminal even though the terminal user is communicating with another terminal user within the coverage area of its own terminal.
- The radio frequency band applied for the radio communication terminal shall be VHF or UHF.
- The radio communication terminal equipment components shall be types whose functions have been confirmed by the business users in foreign countries excluding the original manufacturing country.
- The radio frequency and radio communication terminal equipment to be utilized shall be licensed by Radio Frequency Directorate of Ministry of Information and Communication.

9.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The equipment components shall be protected with measures against interference from

other electronic devices.

- The radio communication terminal equipment component shall have sufficient durability for operating 24 hours a day, 365 days a year.
- The structure of Radio Communication Terminal shall be capable to replace the faulty parts simply and easily when it is detected.

9.3 Performance

- The radio communication terminal equipment component shall allow simple operation.
- The radio communication terminal equipment component shall be capable to produce sound clearly so that the terminal user is able to hear the voices easily under the noise conditions of expressway roadside.

9.4 Human Machine Interfaces

- The radio communication terminal equipment component shall have human-machine interface so that be equipped with directive notification alert such as buzzer for the terminal user when it receives directive communication.
- The radio communication terminal equipment component shall be equipped with response function to acknowledge a directive to the console in road management office after terminal user acknowledges receiving the directive communication.

9.5 Communication Interfaces

- All interfaces of radio communication terminal equipment components to be installed in Road Management Office area shall be compatible with each other and shall not be a hindrance to interactive voice communication.

9.6 Installation

- The Installation work shall include equipment component's unloading, customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.

10. Ambient Conditions

- The radio communication equipment component to be installed in Road Management Office such as equipment components for console and radio transmission, shall be housed in the air conditioned clean room or chassis to maintain the proper performance of the equipment components.
- The terminal equipment component such as handset shall be protected with IP54 or equivalent.
- Equipment components to be installed outside shall be capable to operate and withstand under the ambient conditions such as natural conditions, meteorological conditions, electromagnetic noise, and other environmental conditions of the Project site in Vietnam. The Contractor shall check ambient conditions of the Project site and proper protection shall be designed for individual equipment components.
- The spare parts of the radio communication equipment components shall be housed in proper conditions such as clean room or chassis to maintain proper performance. The conditions shall be subject to the individual equipment components requirements for storage environment.

11. Power Supply

- The main power supply shall be AC220 volts, single phase and 50 Hz frequency.
- The electric power supply for the equipment components of the base station of the radio communication shall be equipped the backup power supply for securing operation of the equipment components for operating 24 hours a day 365 days a year.

12. Maintainability

- The equipment components shall allow to be maintained easily and simply
- The radio communication equipment components shall be capable to identify the faulty parts easily in case a fault is detected, and the replacement of the parts shall be simple.
- The spare parts of radio communication equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the radio communication equipment components shall submit the necessary documents required for the operation and maintenance such as manuals and checklist, and provide necessary training to Operation and Maintenance staff of the related equipment components.
- The manufacturer/supplier of the radio communication equipment components shall make a contract for technical support of operation and maintenance related to the

delivered equipment components with the road management authority. The manufacturer/supplier shall provide the necessary services based on the contract.

13. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit a copy of the ISOI9001 authentication document specified above attached with tender or prequalification proposal.

14. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions:

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test between console to be installed at road management center and terminal equipment components, and between terminal equipment components. The coverage area test shall also be included in the connection test.

(3) There are also three types of inspections similar to the tests, The connection inspection are to basically be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test for radio communication between Radio Communication Terminal and Mobile Radio Console shall be submitted to the road management authority and the consultant.

(8) After approval of the connection test procedure, the contractor 's own connection test shall be implemented and the test result shall be submitted to the road management authority and the consultant.

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant.

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(11)
Traffic Information

1. General Outlines

This functional package allows the road operators to provide other organizations and individuals with the information organized as traffic events on the expressways by using the Internet.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed in the Main Centers of the expressway network for activating functional packages.

3. Relevant Regulations and Standards

- ISO 14813-1:2007: Intelligent transport systems – Refernce model architecture(s) for the ITS sentor – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- ISO/CD 24533: Data directory and Message set for tracking of freight and It's intermodal transfer

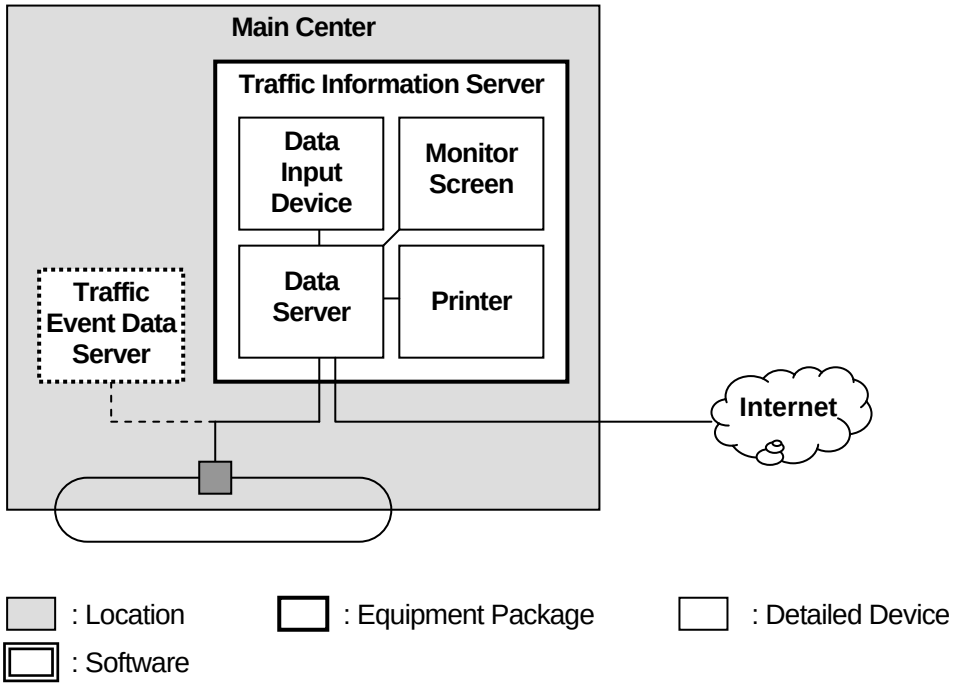
4. Requirements

- System shall be capable of disseminating information on traffic and road condition of the expressway network to the Internet Users.
- System shall be capable of disseminating information based on the traffic event data stroed in the surver.
- System shall be capable of disseminating information, which includes the contents of incidents, traffic conditions, traffic congestion, bad weather, construction works on the expressways and traffic restrictions.
- System shall be capable to allow operators to control the type of data and frequency for disseminating information.
- System shall be capable of generating required reports and printout these reports.
- System shall be capable of allowing securing sufficient durability and reliability of equipment components in the ambient conditions in the main center.

5. System Architecture

System architecture for traffic information is shown below.

Figure 5.1 System Architecture for Traffic Information



6. Traffic Information Server

6.1 Functions

- To retrieve data from Traffic Event Data Server in Main Center in order to compiling traffic information for broadcast. The broadcast information contains traffic, road conditions, incidents, weather information and other related information.
- To generate data to disseminate as information for internet users to receive formatted traffic information from their homes, places of work, over multiple types of electronic media.
- The server application shall be capable of disseminating traffic conditions and incident information to internet users with text and traffic map.
- The server application shall be capable of disseminating maintenance and construction work activities, traffic regulation information to internet users, including anticipated closures and impact to the roadway, alternate routes, anticipated delays, speed limitations, closure times and durations.
- The server application shall provide capability for operators to input broadcast price data including parking price in rest area, toll amount for each vehicle class on expressway sections.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- Chassis of equipment shall not be opened easily, and the door on the chassis shall be equipped with a lock.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices
- The Traffic Information Server shall have sufficient durability for 24hours a day, 365 days a year.
- The structure of Traffic Information Server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Traffic Information Server shall be capable to implement the periodical checking and clean up activities.
- The equipment components of Traffic Information Server shall be installed in the Main Center.

6.3 Performance

- The server application shall be capable of retrieving from Traffic Event Data Server in the Main Center, compiling it, and broadcasting incident information to internet users. The incident information for broadcast contains the data set described in Table 6.1.
- The server application shall be capable of retrieving from Traffic Event Data Server in the Main Center, the significant weather data, compiling it and broadcasting significant weather information to internet users.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The server application shall be capable of disseminating traffic conditions and incident information to internet users with text and traffic map.
- The server application shall be capable of disseminating maintenance and construction work activities, traffic regulation information to internet users, including anticipated closures and impact to the roadway, alternate routes, anticipated delays, speed limitations, closure times and durations.
- The server application shall provide capability for operators to input broadcast price data including parking price in rest area, toll amount for each vehicle class on expressway

sections.

- The server application shall be capable of printing out the report of disseminated information.
- The Traffic Information Server should be setup as a server cluster (a group of servers working together as a single system) to provide high availability of services for clients. When a failure occurs on one computer in a cluster, resources are redirected and the workload is redistributed to another computer in the cluster.
- The Traffic Information Server shall be capable of implementing data backup on a schedule.
- The server application shall be capable of automatically updating of traffic information.
- The Data Server shall have storage capacity to store all data on traffic event data.
- The Data server shall be capable of executing backup of the stored data in the data server on the date which is set up in advance.
- The Data server shall be capable of executing the restoration of backup data.
- The Data Server shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).

6.4 Human Machine Interface

- The Traffic Information Server should be equipped with necessary Human Machine Interfaces such as monitor, keyboard and mouse.
- The traffic data server shall be capable of management by remote control.

6.5 Communication Interface

- The system shall be capable of transmitting all data and signal over TCP/IP.
- The system shall be capable of being equipped with following communication interfaces between transmission devices:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

6.6 Installation

- The server application shall be installed on the operating system such as Windows, Linux etc which is widely available in many countries.
- The equipment components of Traffic Information Server shall be installed in the Main Center.
- The Traffic Information Server shall have web server software such as apache or IIS or etc.
- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Traffic Information Server shall be installed in air conditioned room in Regional Main Center.
- The Traffic Information Server shall be arranged in DMZ (demilitarized zone) of network for ITS.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

7. Ambient Conditions

- The equipment component shall be installed in the office which is protected from interferences of other electronic devices.
- The equipment component shall be capable of operating normally under the ambient conditions of average temperature 25 +/- 3 degree C and relative humidity between 20 and 80 %.
- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Main Center.

8. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- System shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 30 minutes.

9. Maintainability

- The equipment components shall be maintained easily and simply.
- The equipment components shall be capable to identify the faulty parts easily in case a fault is detected, and the replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.
- The manufacturer of the equipment components shall make a contract for technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer shall provide the necessary services based on the contract.

10. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit a copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

11. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions;

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer

and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least the inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation:

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in the appropriate timing before commencement of the tests and inspections, respectively in hard copy including following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, checklist which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank

space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project.

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission document

(12)
Integrated Data Management

1. General Outlines

This functional package allows road operators to utilize acquired data such as traffic events, traffic volume, large vehicle ratio and measured axle loads of heavy trucks for developing inspection and budget plan of road maintenance and to check validity of toll revenue in comparison with traffic data.

2. Scope

This Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, and in the Main Center of the expressway network for actualizing this functional package.

3. Relevant Regulations and Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- ISO/CD 24533: Data directory and Message set for tracking of freight and It's intermodal transfer

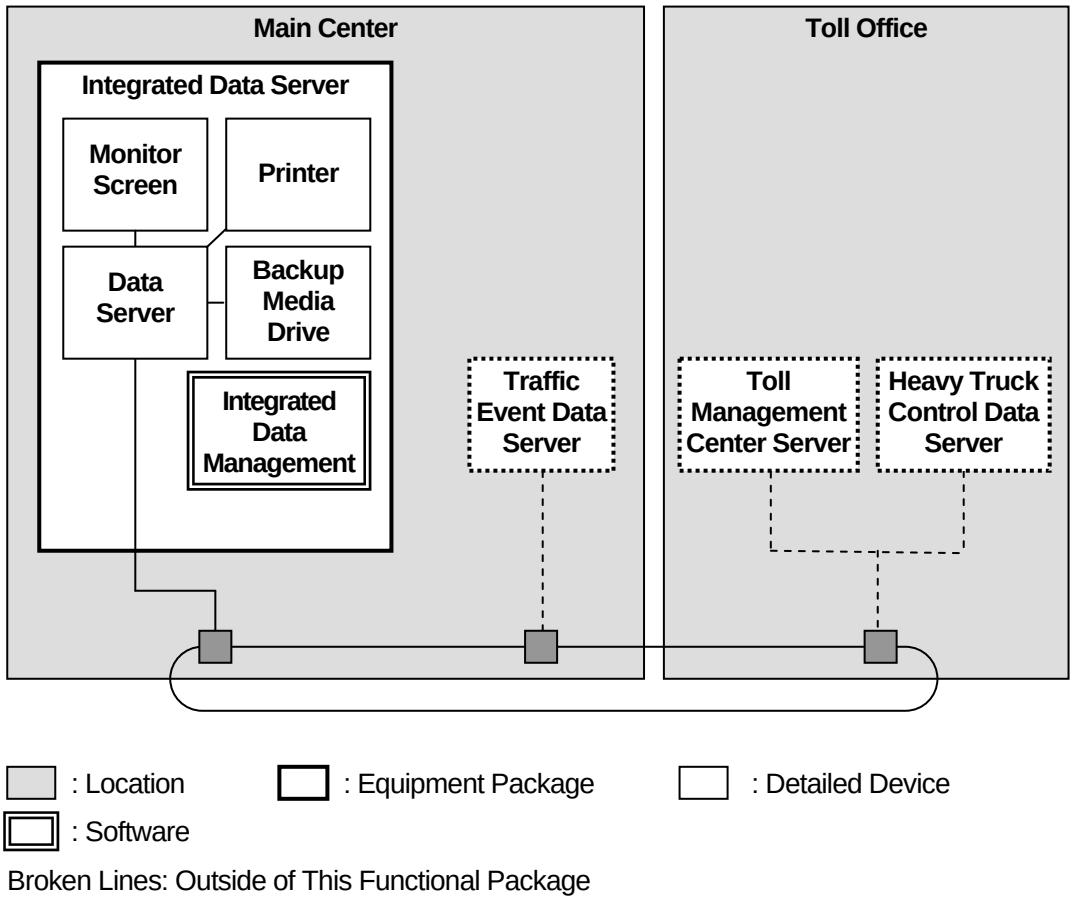
4. Requirements

- System shall be capable of integrating the recorded data for traffic information/control, toll collection and vehicle weighing.
- System shall be capable of integrating the data sets of incident, traffic volume, traffic congestion, bad weather, construction work, traffic restriction, traffic event, hourly toll collection and axle load management into a form of historical data records.
- System shall be capable of compiling the recorded data corresponding to date/time and kilo-meter post of a road section.
- System shall be capable of sorting/displaying/printing-out the historical data records in the form of list, table and graph for developing inspection/budget plan of road maintenance.
- System shall be capable of searching/calculating values required for checking validity of toll revenue in comparison with traffic data.
- System shall be capable of functioning 24 hours a day, 365 days a year by a redundant system and sufficient durability/reliability of equipment components.

5. System Architecture

System architecture for Integrated Data Management is shown below.

Figure 5.1 System Architecture for Integrated Data Management



6. Integrated Data Server

6.1 Functions

- To retrieve data from Traffic Event Data Server in Main Center in order to compiling traffic event for management.
- To retrieve data from Toll Management Center Server in Toll Office in order to compiling toll revenue for management.
- To retrieve data from Heavy Truck Control Server in Toll Office in order to compiling axle load measurement data for management.
- The Server application shall be capable of displaying history of traffic event and toll revenue and axle load measurement data to VEMO with table and graph.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- Chassis of equipment shall not be opened easily, and the door on the chassis shall be equipped with a lock.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices
- The Integrated Data Server shall have sufficient durability for 24hours a day, 365 days a year.
- The structure of Integrated Data Server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Integrated Data Server shall be capable to implement the periodical checking and clean-up activities.
- The equipment components of Integrated Data Server shall be installed in the Main Center.

6.3 Performance

- The Integrated Data Server shall have storage capacity to store all data on traffic event, toll revenue and axle load measurement.
- The Integrated Data server shall be capable of executing backup of the stored data in the integrated data server on the date which is set up in advance.

- The Integrated Data server shall be capable of executing the restoration of backup data.
- The Integrated Data Server shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).

6.4 Human Machine Interfaces

- The Integrated Data Server should be equipped with necessary Human Machine Interfaces such as monitor, keyboard and mouse.
- All consoles shall have user-friendly interface.
- The system shall be capable of displaying the retrieved results on the monitor screen.
- The system shall be capable of printing information which is displayed on Monitor Screen.
- The system shall be capable of printing retrieved results by A4/A3 type printer.
- The Integrated Data server shall be capable of management by remote control.

6.5 Communication Interfaces

- The system shall be capable of transmitting all data and signal over TCP/IP.
- The system shall be capable of being equipped with following communication interfaces between transmission devices:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

6.6 Installation

- The server application shall be installed on the operating system such as Windows, Linux etc. which is widely available in many countries.
- The equipment components of Integrated Data Server shall be installed in the Main Center.
- The Integrated Data Server shall have database system such as Oracle or MySQL or etc.
- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such

as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.

- The Toll Management Center Server shall be installed in air conditioned room in Regional Main Center.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

8. Ambient Conditions

- The equipment component shall be installed in the office and shall be protected with the measures against interferences of other electronic devices.
- The equipment component shall be capable of normally operating in ambient conditions. Ambient conditions are shown in the table below.
- The equipment component shall be capable of operating normally in the ambient conditions of temperature 25 +/- 3 degrees C in average with relative humidity between 20 and 80 %.
- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Main Center.

9. Power Supply

- The main power supply is AC 220 volts single phase and 50 Hz frequency. For stable supply of power, the subsystem requires to install UPS (Uninterrupted Power Supply Unit), which accommodates a surge or voltage variation that may occur on the main power supply.

10. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The equipment components shall be capable of identifying the faulty parts easily in case it is detected, and the replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the necessary documents necessary for the operation and maintenance such as manuals and check list, and necessary training shall be provided to the staffs to be work as O&M staffs of the related equipment components.
- The manufacturer of the equipment components shall make a contract on technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer shall provide the necessary services based on the contract.

11. Quality Control

- The manufacturer of the equipment components shall have the authentication of ISO9001 on manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.

- The manufacturer shall be required to submit the copy of the evidenced document of the ISO9001 authentication specified above attached with tender or prequalification proposal.

12. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions;

(1) The test means own test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant, and if it is completed successfully, it will be accepted.

(2) There are three types of test such as factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests, The factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include the inventory check, visual inspection, and performance test at least, respectively.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory own test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant

(8) After approval of the connection test procedure, the contractor's own connection test and the test result shall be submitted to the road management authority and the consultant

(9) The inspection for the system connection shall be implemented witnessed by the road management authority and the consultant

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in the appropriate timing before commencement of the tests and inspections, respectively in hard copy including followings;

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space to filling out the test or inspection result.

(2) In the checklist, the blank space to fill out the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

The following conditions shall be determined in each project at least.

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's individual own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission document

(13)
Tollgate Lane Monitoring

1. General Outline

This functional package allows the road operators to monitor current conditions of vehicle passage and operations by workers by using cameras installed in a separated lane such as a tollgate lane of the expressway.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, and in tollbooths and toll offices of the expressway network for activating functional packages.

3. Relevant Regulations and Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sentor – Part 1: ITS service domains, service groups and services
- IEC 60529: Degrees of Protection provided by Enclosure (IP Code)
- ISO/IEC 14496-2: (MPEG4-Part 2)
- IEEE 802.3: (Ethernet)
- ISO/IEC 14496: (Coding of audio-visual objects)

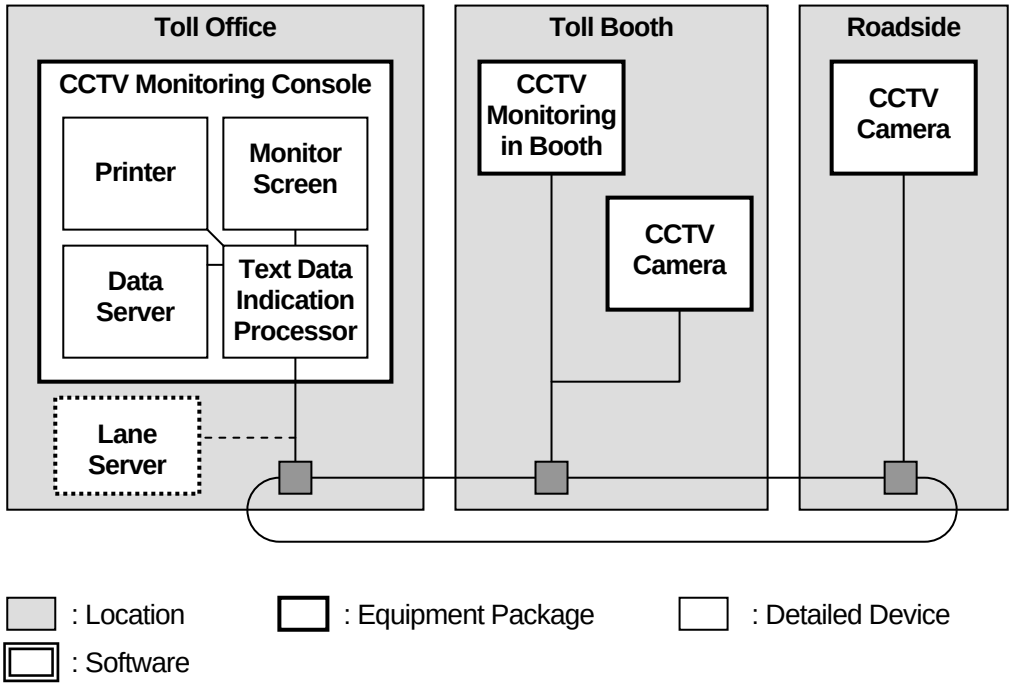
4. Requirements

- System shall be capable of monitoring vehicles passing through a tollgate lane, in the toll booth and toll office, and identifying their type such as truck, bus and sedan.
- System shall be capable of monitoring toll payment/receipt transaction between a driver and a toll collector in the toll office.
- System shall be capable of storing the needed video images.
- System shall be capable of showing and printing out the needed results.
- System shall be capable of installing roadside equipment adequately in the limited space around a tollgate lane.
- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

5. System Architecture

System architecture for tollgate lane monitoring is shown below.

Figure 5.1 System Architecture for Tollgate Lane Monitoring



6. CCTV Camera

6.1 Functions

- To monitor vehicles in the toll lane and identify types of the vehicles by their appearance.
- To supervise money transferring transactions between toll collector and driver.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The equipment components shall be capable of synchronizing its clock to the clock of "CCTV Monitoring Console" at start-up.
- CCTV system shall be capable of correcting brightness of captured image automatically. (That is called as the iris function.)
- CCTV system shall have auto-focus function to be controlled from "CCTV Monitor Console".
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with the measures against water, rust, dust, salt water in case equipment components are installed outdoors.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow maintenance works from the sides and/or back, but not from lane direction, in order to minimize the influence to traffic activities.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with the measures against interference from other electronic devices.
- Fixed CCTV camera shall be protected against dust and water ingress if it will be installed outdoors in road typical section in accordance with IP66 of the international standards IEC 60529 or equivalent.
- The system shall be capable of fully meeting the requirements even under night conditions.
- The Fixed camera shall be capable of complying with CS–mount standards.

6.3 Performance

There are two types of CCTV camera: Panning/Tilting/Zooming (PTZ) Type and Fixed Type.

- Panning/Tilting/Zooming (PTZ) Type camera: The camera shall have panning/tilting and zooming functions
- Fixed Type camera: The camera does not have panning/tilting functions, and may have zooming function.

The general requirement for both types are as follow:

- The system shall be capable of controlling the lens aperture in tune with the brightness of the subject and of outputting the best suited video image.
- The system shall have video image output interface to adjust angle of view of camera and receiving control signal interface to check camera operations at setup at installation site.
- The equipment components shall be capable of taking images road traffic by at least Black/White image for continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The equipment component shall be supplied with Device Driver for controlling camera functions. ONVIF compliance is required for CCTV cameras.

Detailed specification of PTZ Type camera:

- Size of image sensor must be greater than 1/4".
- Minimum focal length of lens must be between 3.0mm and 5.0mm.
- The camera resolution must be greater than 1 mega pixel or 1280x720.
- The minimum illumination in day mode and night mode should be lower than 1.0 lx and 0.3 lx respectively, without slow shutter function.
- The camera must be capable of encoding in H.264, MPEG4-Part2 and Motion JPEG.
- The camera must be able of panning at least 350 degrees and tilt 100 degrees.
- The camera must be capable of using x10 optical zooming.
- The frame rate should be greater than 25 fps
- The camera must consumed power less than 100W
- The camera can operate at -30 to 50 degrees with humidity range from 20 to 90% (non-condensing).
- The device's weight should be less than 5.0 kg.

Detailed specification of Fixed Type camera:

- Size of image sensor must be greater than 1/4".
- Minimum focal length of lens must be between 3.0mm and 5.0mm, and may be changed based on CS mount lens.
- The camera resolution must be greater than 1 mega pixel or 1280x720.
- The minimum illumination in day mode and night mode should be lower than 1.0 lx and 0.1 lx respectively, without slow shutter function.
- The camera must be capable of encoding in H.264, MPEG4-Part2 and Motion JPEG.
- The camera shall be protected in accordance with IP66, ISO/IEC 60529.
- The frame rate should be greater than 25 fps.
- The camera must consumed power less than 50W.
- The camera can operate at -30 to 50 degrees with humidity range from 20 to 90% (non-condensing).
- The maximum surveillance range should be greater than 30m without zooming functions.
- The device's weight should be less than 4.0 kg.

6.4 Human Machine Interfaces

- CCTV camera shall have the function to output test image to personal computers at site so that installation staff may adjust the direction of the camera.
- The system shall have video image output interface to adjust angle of view of camera and receiving control signal interface to check camera operation at setup at installation site.

6.5 Communication Interface

- The system shall be capable of providing control signal to transmit the images over TCP/IP.
- The equipment components shall be capable of having following communication interfaces in order to ensure that equipment components to be controllable with CCTV, and accessible to CCTV video images from another equipment / console.
  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Transmission data format
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be

capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

6.6 Installation

Installation of PTZ Type camera in the toll booth:

- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The equipment components shall be installed in the toll booth where they are capable of taking images of the toll collector's dose-range activity.
- Horizontal and vertical angle of CCTV camera shall be adjustable and shall be fixed appropriately.
- CCTV camera shall be capable of being vertically and horizontally adjusted during installation in toll booth.

Installation of Fixed Type camera at the toll island:

- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The equipment components shall be installed at the toll island where they are capable of taking images of the front image of vehicles (including Licence Plate) .
- Horizontal and vertical angle of CCTV camera shall be adjustable and shall be fixed appropriately.
- CCTV camera shall be capable of being vertically and horizontally adjusted during installation at roadside.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.
- CCTV cameras shall be installed so that direction of camera may not be rotated by strong wind.
- CCTV camera shall be installed so that images may not swing by strong wind.In case the equipments to be located at outdoor, the screw for attachment should be antitheft type.
- In case the equipments to be located at outdoor, the screw for attachment should be antitheft type.

7. CCTV Monitoring in Toll Booth

7.1 Functions

- To monitor vehicles in the toll lane and of identify vehicles by their appearance.
- Equipment components shall be capable of synchronizing their clocks to the clock of "CCTV Monitoring Console" at start-up.
- Equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices

7.3 Performance

- The equipment of components shall be capable of displaying CCTV camera images.
- Recommended size of monitor screen is (approx.) 20 inches or over.
- Telephones shall be equipped at toll booth for communication between Toll Collector and Toll Management Office.
- CCTV camera shall be capable of taking images of road traffic in at least Black/White continuous for 24 hours a day for 365 days a year, except for maintenance and repair period.

7.4 Human Machine Interfaces

- The system shall be equipped with functions of panning, tilting, and zooming of cameras using keyboards, joysticks and track balls by operators at the Toll booth are monitoring the images taken by CCTV cameras.

7.5 Communication Interface

- The system shall transmit all data and signals over TCP/IP.
- The equipment components shall have the following communication interfaces in order to ensure that equipment components are CCTV controllable, and CCTV video images are accessible from another equipment / consoles.
  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Transmission data format
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

7.6 Installation

- The software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The equipment components shall be installed in the Toll booth.

8. CCTV Monitoring Console

8.1 Functions

- To monitor vehicles in the toll lane and identify the vehicles by their appearance.
- To supervise the money transferring transaction between toll collector and driver.
- The equipment components shall be capable of synchronizing their clocks to the clock of "Traffic Supervising / Control Server" at start-up.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices.

8.3 Performance

- The equipment components shall display the images captured by CCTV camera.
- The system shall control the zoom, pan/tilt functions of all cameras.
- The system shall display the camera image selected by the operating staff on the monitor.
- Recommended size of monitor screen is (approx.) 20 inches or over.
- The system shall allow operating staff to monitor all displayed images .
- However, some issues are as follows:
  - The room space not enough to locate all necessary Monitor Screens.
  - The number of operators not enough for monitoring all CCTV images displayed on Monitor Screens.

  Therefore, number of monitors should be controlled as follows:

- Multiple images shall be separately displayed on the same Monitor Screen.
- Images of different cameras shall be displayed on the same Monitor Screen with defined rotating intervals.

- The system shall capture CCTV images as still pictures.
- The system shall print the captured image using A4 type printer.
- The system shall print the displayed images using A4 type printer.
- Telephones shall be equipped for communication between Toll Collector and Toll Management Office.
- The system shall accumulate captured CCTV images in a database at Data Server. Additionally, the system shall store accumulated images for a certain time (approx. 30 days)
- The system shall display accumulated CCTV images on the monitor screen.
- CCTV camera shall take images of road traffic in at least Black/White continuously for 24 hours a day for 365 days a year, except for maintenance and repair period.

8.4 Human Machine Interface

- The equipment components shall have human-machine interface for the Traffic Information Operator to input necessary commands into the system.
- The display unit shall have the input and output terminals, such as D-sub, HDMI, RS-232C and LAN port.

8.5 Communication Interface

- The system shall transmit all data and signals over TCP/IP.
- The equipment components shall have the following communication interfaces in order to ensure that equipment components are CCTV controllable, and CCTV video images are accessible from another equipment / consoles.
  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Transmission data format
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

8.6 Installation

- The software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The equipment components shall be installed in the Toll Office.

9. Ambient Conditions

- The equipment components shall be installed in the offices, toll booth, outside and shall be protected with the measures against interferences of other electronic devices.
- The equipment component shall be capable of normally operating under the following ambient conditions.

For Main Center, Toll Management Center, and Toll Office
Temperature: 25 +/- 3 degree C in average
Relative humidity: between 20 and 80 % in average
For outside
Temperature: between - 0 and +50 degree C
Relative humidity: below 95 %

10. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for at least 30 minutes.

11. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The system shall be capable of identifying the faulty parts easily in case equipment fault is detected, and replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.
- The manufacturer of the equipment components shall make a contract for technical support of operation and maintenance related to the delivered equipment components with the road management authority. The manufacturer shall provide the necessary services based on the contract.

12. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit a copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

13. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions:

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant.

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant.

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant.

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including the following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(14)
Vehicle/Class Identification

1. General Outline

This functional package allows the road operators to identify individual vehicle and its vehicle class for calculating toll rate and allows drivers and toll collectors to ascertain the identified results by using a license plate scanner and other equipment installed in a separated lane such as a tollgate lane of the expressway.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, and in tollbooths of the expressway network for activating functional packages.

3. Relevant Regulations and Standards

1) International Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- ISO/IEC 14496-2: (MPEG4-Part 2)
- ISO/IEC 14496: (Coding of audio-visual objects)

2) National Standards

- TCVN 4054:2005: Highway - Specifications for Design
- TCVN 5729
- Ministry of Public and Security under Circular No 06/2009/TT-BCB(C11)

4. Requirements

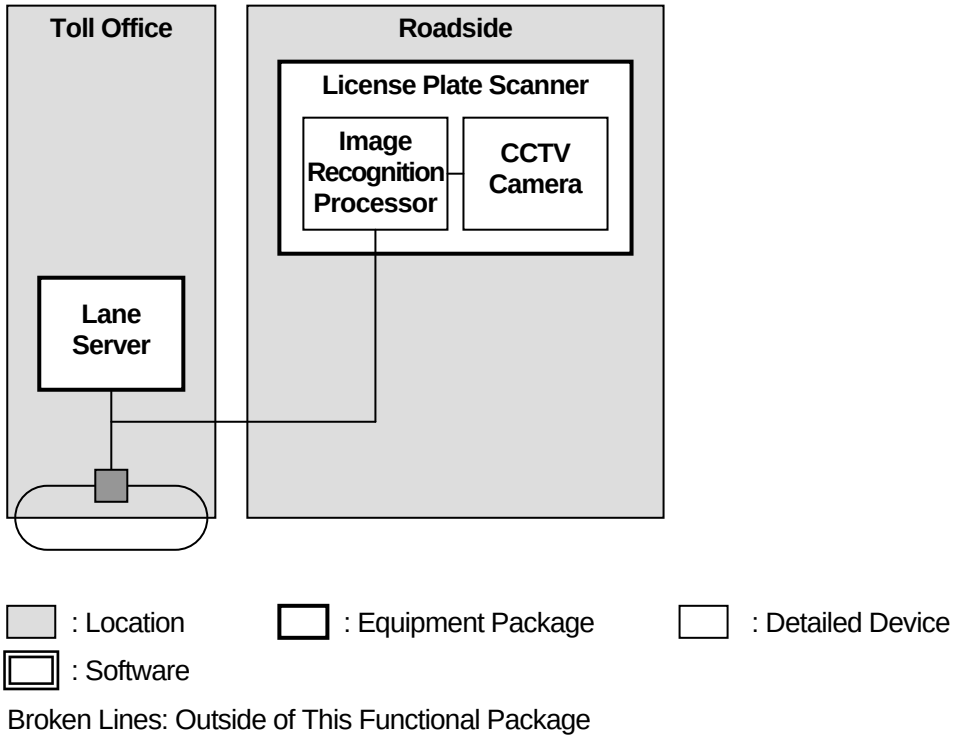
- System shall be capable of identifying the classes of vehicles passing through a tollgate lane, such as trucks, buses and sedans.
- System shall be capable of identifying the vehicles passing through a tollgate lane by their license number plate and storing the results.
- System shall be capable of allowing installing roadside equipment adequately in the limited space around a tollgate lane.

- System shall be capable of allowing securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

5. System Architecture

System architecture for vehicle/class identification is shown below.

Figure 5.1 System Architecture for Vehicle/Class Identification



6. CCTV Camera

6.1 Functions

- To monitor vehicles on the expressway and identifying types of the vehicles by their appearances.
- To take an image of vehicle license number plate upon control signal.
- CCTV system shall be capable of correcting brightness of captured image automatically. (That is called the iris function.)
- CCTV system shall have auto-focus function to be controlled by using “CCTV Monitor Console”.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The system shall be capable of synchronizing its clock to the clock of “Traffic Supervising / Control Server” at start-up.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

6.2 Structure

- Countermeasures against dust and rain shall be taken on the CCTV camera installed outside (except tunnels) in accordance with IPX66 of the international standard IEC 60529 or equivalent.
- The system shall be capable of fully meeting the requirements even under night conditions.
- The camera shall be capable of complying with CS–mount standard.
- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoors.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow performing maintenance works from the sides and/or back, but not from lane direction, in order to minimize the influence to traffic activities.
- The chassis of equipment shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.

6.3 Performance

- The system shall be capable of controlling the lens aperture in tune with the brightness of the subject and of outputting the best suited video image.
- The system shall have video image output interface to adjust angle of view of camera and receiving control signal interface to check camera operations at setup at installation site.
- The equipment components shall be capable of taking images road traffic by at least Black/White image for continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- Size of image sensor must be greater than 1/4".
- The camera resolution must be greater than 1 mega pixel or 1280x720.
- The minimum illumination in day mode and night mode should be lower than 1.0 lx and 0.1 lx respectively, without slow shutter function.
- The camera must be capable of encoding in H.264, MPEG4-Part2 and Motion JPEG.
- The camera shall be protected in accordance with IP66, ISO/IEC 60529.
- The frame rate should be greater than 25 fps.
- The camera must consumed power less than 50W.
- The camera can operate at -30 to 50 degrees with humidity range from 20 to 90% (non-condensing).
- The system shall be capable of controlling the lens aperture per the brightness of the subject and of outputting good quality video image.
- The system shall be capable of zooming, correcting brightness and focusing of the camera according to the control signal.
- The equipment components shall be capable of setting the shutter speed when capturing the image of vehicle license number plate.
- The equipment components shall be capable of transmitting the image of vehicle license number plate to “Image Recognition Processor”.
- The system shall have video image output interface to adjust angle of view of camera and control signal receiving interface to check setup of camera operations at installation site.
- CCTV camera shall be capable of taking images of road traffic by at least Black/White image continuously for 24 hours a day for 365 days a year, except for maintenance and repair period.
- The system shall have zoom function.
- The equipment component shall be supplied with Device Driver for controlling camera functions of zooming. The camera shall be supported by interface of “CCTV Monitoring Console” if possible.

- The function of zooming of the CCTV cameras shall be controlled remotely by using a keypad of the console in the Toll Office. The camera control shall be conducted using IP address corresponding to the camera identification number.

6.4 Human Machine Interfaces

- The system shall be equipped with functions of panning, tilting, and zooming of cameras using keyboards, joysticks and track balls by operators at the Toll booth are monitoring the images taken by CCTV cameras.

6.5 Communication Interface

- The system shall provide control signal for image transmitted over TCP/IP.
- The equipment components shall have the following communication interfaces in order to ensure that equipment components are CCTV controllable, and CCTV video images are accessible from other equipment / consoles.
  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Transmission data format
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

6.6 Installation

- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The equipment components shall be installed on the toll island where they are capable of taking an image of the front of a vehicle (included Licence Plate).
- Horizontal and vertical angle of CCTV camera shall be adjustable, and shall be fixed appropriately.
- CCTV camera shall be capable of being vertically and horizontally adjusted during installation at site.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.

- CCTV cameras shall be installed so that direction of camera may not be rotated by strong wind.
- CCTV camera shall be installed so that images may not swing by strong wind.

7. Image Recognition Processor

7.1 Functions

- The equipment components shall be capable to recognize vehicle license number plate in the toll lane and to automatically identify the vehicle class, The result of recognition is to be transmitted to “Toll Office Server”.
- The system shall be capable of synchronizing its clock to the clock of “CCTV Monitoring Console” at start-up.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case the equipment components are installed outdoor.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow performing maintenance works from the sides and/or back, but not from lane direction, in order to minimize the influence to traffic activities.
- The chassis of equipment shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.

7.3 Performance

- The system capable of recognize the licence plate, in case the vehicle speed is more than 80km/h.
- The equipment of components shall be capable of automatically recognizing Vehicle license number plate according to “Ministry of Public and Security under Circular No 06/2009/TT-BCB(C11)”

- The equipment components shall be capable of transmitting the recognized Vehicle license number plate and related information to “Lane Server”.
- The equipment of components shall be capable of digitising and outputting the reliability of recognition result which represents the accuracy of the number plate recognition results.
- In case of recognition results below the threshold reliability level, the equipment components shall be capable of indicating relevant text information (such as number plate information) as “F” instead of recognition results.
- The equipment of component shall be capable of transmitting the image of vehicle license number plate to “Lane Server”.
- All results of event detection shall be logged including not transmitted results
- The system shall have video image output interface to adjust angle of view of camera and control signal receiving interface to check camera operations for setup at installation site.

7.4 Human Machine Interfaces

- The system shall be equipped with the functions that the operator of the toll office is able to visually recognize the license plate number by indicating images taken by CCTV cameras.

7.5 Communication Interface

- The system shall be capable of controlling the signal for images transmitted over TCP/IP.
- The transmission devices shall have the following communication interfaces;
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

7.6 Installation

- The software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The equipment components shall be installed in the Toll Office.

8. Ambient Conditions

- The equipment components shall be installed in the offices, toll booth, outside and shall be protected with measures against interference of other electronic devices.
- The equipment components shall be capable of operating normally under the following ambient conditions:

For Main Center, Toll Management Center, and Toll Office
Temperature: 25 +/- 3 degree C in average
Relative humidity: between 20 and 80 % in average
For outside
Temperature: between - 0 and +50 degree C
Relative humidity: below 95 %

9. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 30 minutes.

10. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The system shall be capable of identifying the faulty parts easily in case equipment fault is detected, and the replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.
- The manufacturer of the equipment components shall make a contract on technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer shall provide the necessary services based on the contract.

11. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit the copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

12. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions:

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least the inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including followings;

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(15)
Lane Control

1. General Outline

This functional package allows the road operators to eliminate the vehicle passages without adequate toll collection by using a computer, vehicle detectors, signs and a barrier installed in a separated tollgate lane of the expressway.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, and in tollbooths of the expressway network for activating functional packages.

3. Relevant Regulations and Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- ISO/CD 24533: Data directory and Message set for tracking of freight and It's intermodal transfer
- TCCS 01:2008/VRA: One-stop Charging Toll Gate using Printed Barcodes
- TVCN 6384:1998: Code/Bar Code on items - UPC-A Code - Technical Requirements
- TVCN 6513:1999: Code/Bar Code on items - Barcode ITF - Technical Requirements
- TVCN 6755:2008 ISO/IEC 15417:2007: Code/Bar Code on items - Barcode EAN-UCC 128 - Technical Requirements

4. Requirements

- System shall be capable of generating/processing the data appropriate for collecting tolls based on the data sent from IC-card and OBU, the results of vehicle class identification and the regulated toll rate system.
- System shall be capable of securing an average service-time by non-stop less than 4.5 sec/vehicle and by one-stop less than 9.0 sec/vehicle.
- System shall be capable of processing the data for collecting toll and giving the vehicle class judged by toll collector a higher priority.
- System shall be capable of notifying a driver, in case of prepaid balance shortage for required toll amount, the necessity to recharge prepaid balance before next time of

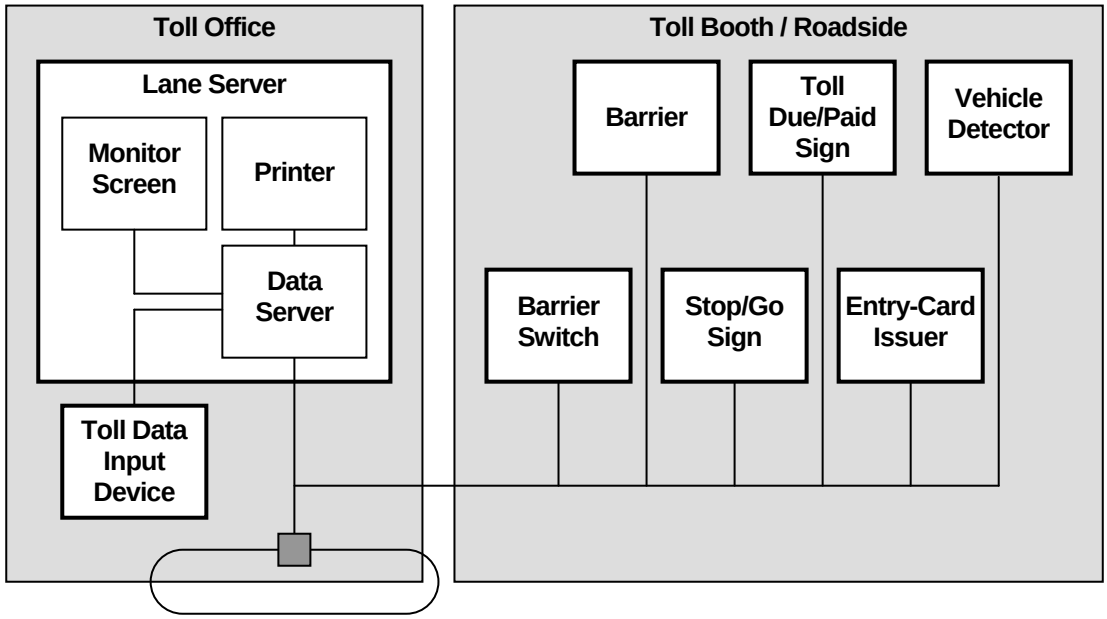
system usage and including the amount of shortage.

- System shall be capable of notifying the data for collecting toll and the results of processing the data.
- System shall be capable of blocking the vehicles without normal completion of toll collection.
- System shall be capable of rejecting entry of the vehicles beyond the legal dimension limits.
- System shall be capable of generating/storing identification data of the vehicles without normal completion of toll collection.
- System shall be capable of indicating and printing out the needed results.
- System shall be capable of allowing installing roadside equipment adequately in the limited space around a tollgate lane.
- System shall be capable of allowing securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.
- System shall be capable of allowing toll collector to collect the proper toll manually in case the registered vehicle type of OBU is obviously judged as error compared with the visually checked one.
- System should be assured to be little affected by noise outside and still execute toll collection quickly and accurately.

5. System Architecture

System architecture for lane control is shown below.

Figure 5.1 System Architecture for Lane Control



: Location : Equipment Package : Detailed Device

: Software

Broken Lines: Outside of This Functional Package

6. Lane Server

6.1 Functions

- To calculat toll fee in accordance with the toll rate system, based on the information from “Roadside Controller”, “IC-Card R/W” and “Toll Data Input Device”.
- To receive the data shown in Tables 7.1, 7.5 and 7.9 from “Roadside Controller”, “IC-Card R/W” and “Toll Data Input Device” at the Entry Tollgate.
- To transmit the data shown in Tables 7.2 and 7.6 to “Roadside Controller”, “IC-Card R/W” and “Toll Data Input Device” at the Entry Tollgate.
- To receive the data shown in Tables 7.3 and 7.7 from “Roadside Controller”, “IC-Card R/W” and “Toll Data Input Device” at the Exit Tollgate.
- To transmit the data shown in Tables 7.4 and 7.8 to “Roadside Controller”, “IC-Card R/W” and “Toll Data Input Device” at the Entry Tollgate.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

1) Touch&Go

- At entry tollgate: The equipment components shall be capable of receiving the data as shown in Table 6.1 from “IC-Card R/W”, and shall be capable of transmitting the data as shown in Table 6.2 to “IC-Card R/W”.
- At exit tollgate: The equipment components shall be capable of receiving the data as shown in Table 6.3 from “IC-Card R/W”, and shall be capable of transmitting the data as shown in Table 6.4 to “IC-Card R/W”.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).

2) ETC

- At entry tollgate: The equipment components shall be capable of receiving the data as shown in Table 6.5 from “Roadside Controller”, and shall be capable of transmitting the data as shown in Table 6.6 to “Roadside Controller”.
- At exit tollgate: The equipment components shall be capable of receiving the data as shown in Table 6.7 from “Roadside Controller”, and shall be capable of transmitting the data as shown in Table 6.8 to “Roadside Controller”.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).

3) Manual collection

- At Entry Tollgate: The equipment components shall be capable of transmitting the data as shown in the table below to “Entry-Card Issuer”.
- At Exit Tollgate: The equipment components shall be capable of receiving the data as shown in the table below from “Toll Data Input Device”.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The equipment components shall be capable of synchronizing time with “Traffic Supervising / Control Server” at start-up.
- The equipment components shall be capable of operating continuously 24 hours a day, 365 days a year, except for maintenance period.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The Lane Server shall have sufficient durability for 24hours a day, 365 days a year.
- The Lane Server shall have the structure which is possible to fix in the building in Toll Booth.
- The structure of Lane Server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Lane Server shall be capable to implement the periodical checking and clean up activities.

6.3 Performance

- The equipment components shall be capable of transmitting all transaction data such as the transaction information that received from “Roadside Controller” or the control information of Sign and Barrier to “Toll Management Server”.
- The equipment components shall be capable of reading "Date of expiry" in the "IC-

Card" and checking whether the card has expired or not. In case the IC card has expired, the following operations shall be performed:
- Displaying the text "Stop" on "Stop/Go" sign board
- Closing "Barrier"

- The equipment components shall be capable of checking whether the most recent transmission has been performed at Entry Tollgate or Exit Tollgate based on the "Termination sign" information read from the "IC-Card".
- The equipment components shall be capable of recording the number of transactions and (corresponding to the passage times through tollgates) pass the information to the "Transaction counter" in "IC-Card" in order to check whether the "IC-card" is counterfeit or not or whether information written on the "IC-Card" is complete or not.
- The equipment components shall be capable of storing the "Invalidation-list" received from "Toll Office Server". The Invalidation list is described in the table below.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- In case "Invalid IC-Card ID" is indicated on the "Invalidation-list", the "Permanently voided code" flag is written on it to express that it is a permanently unusable card.
- The equipment components shall be capable of checking whether the card is permanently unusable or not by reading "Permanently voided code" in the "IC-Card". In case of the card is permanently unusable, the following operations shall be performed:
  - Displaying the text "Stop" on "Stop/Go" sign board
  - Closing "Barrier"
- The equipment components shall be capable of receiving the number of passing vehicles at Tollgate from "Vehicle Detector" and transmitting it to "Toll Office Server".
- In order to slowdown the speed of vehicle to under 40 km/h, when the toll billing process finish, the barrier will be lifted after a certain time lag.
- Since the time lag is calculated based on the length of Toll Island, it is possible to set up each Toll lane differently.

1) Touch&Go/Manual

- The equipment components shall be capable of transmitting the "Vehicle class" information received from "Toll Data Input Device" to "Classification Sign". The "Vehicle class" is chosen and input by "Toll Collector".
- In case the IC-Card ID is not found on the "Invalidation list": The equipment components shall be capable of calculating the toll amount based on the information sent from "Toll Data Input Device", "IC-Card R/W" and "Entry-Card", such as IC-Card ID, Tollgate ID, Vehicle Class, and performing the following operations:
- At entry tollgate:

- Displaying the Vehicle Class on “Classification Sign”.
- Writing the Tollgate ID, Lane Server ID, Date / Time and Completion / end sign on IC-Card by “IC-Card R/W”
- Displaying the text “Go” on “Stop/Go” sign board
- Opening Barrier

- At exit tollgate:
  - Displaying the Vehicle Class on “Classification Sign”.
  - Displaying the status of toll collection on “Toll Due/Paid” sign board
  - Writing the “Prepaid balance”, “Tollgate ID”, “Lane Server ID”, “Date / Time”, “Toll amount”, “Completion / end sign” and “Transaction counter” on IC-Card by “IC-Card R/W”
  - Displaying the text “Go” on “Stop/Go” sign board
  - Opening Barrier
- The equipment components shall be capable of writing a Remark on the “Termination sign” in “Transaction Data Set”. This remark helps to determine whether the transmission (writing Entry Tollgate Information, processing Toll Collection, processing Recharge) was performed normally at the Entry Tollgate and the Exit Tollgate.
- At entry tollgate: The equipment components shall be capable of writing the entry tollgate information (as Table 1 and Table 5), without considering whether the “Termination sign” is written or not.
- At exit tollgate: The equipment components shall be capable of performing the following operations in case the “Termination sign” is not written.
  - Displaying the text “Stop” on “Stop/Go” sign board
  - Closing barrier
- The system shall be capable of performing the following operations if IC-Card ID is found on the “Invalidation list”:
  - writing “Permanently voided code” on the IC-Card
  - displaying the text “Stop” on “Stop/Go” sign board
  - closing barrier
- In case the “IC-Card” balance is insufficient, the system shall be capable of receiving the “Warning Command” sent from ”IC-Card R/W” and performing the following operations:
  - Informing the Toll Collector about shortage
  - Display “Stop” to “Stop / Go Sign”.
  - Closing Barrier

2) ETC

- The equipment components shall be capable of transmitting the “Vehicle class” information received from “Roadside Controller” to “Classification Sign”.
- In case the IC-Card ID is not found on the “Invalidation list”: The equipment components shall be capable of calculating the toll fare based on the information sent from “Roadside

Controller", such as IC-Card ID, Tollgate ID, Vehicle Class, and performing the following operations:

- At entry tollgate:
  - Displaying the Vehicle Class on "Classification Sign".
  - Writing the Tollgate ID, Lane Server ID, Date / Time and Completion / end sign on IC-Card by "Roadside Antenna"
  - Displaying the text "Go" on "Stop/Go" sign board
  - Opening Barrier
- At exit tollgate:
  - Displaying the Vehicle Class on "Classification Sign".
  - Displaying the status of toll collection on "Toll Due/Paid" sign board
  - Writing the "Prepaid balance", "Tollgate ID", "Lane Server ID", "Date / Time", "Toll amount", "Completion / end sign" and "Transaction counter" on IC-Card by "Roadside Antenna"
  - Displaying the text "Go" on "Stop/Go" sign board
  - Opening Barrier
- The equipment components shall be capable of writing a Remark on the "Termination sign" in "Transaction Data Set". This remark helps to determine whether the transmission (writing Entry Tollgate Information, processing Toll Collection, processing Recharge) was performed normally at the Entry Tollgate and the Exit Tollgate.
- At entry tollgate: The equipment components shall be capable of writing the entrance information (as Table 1 or Table 5), without considering whether the "Termination sign" is written or not.
- At exit tollgate: The equipment components shall be capable of performing the following operations in case the "Termination sign" is not written.
  - displaying the text "Stop" on "Stop/Go" sign board
  - Closing barrier
- The system shall be capable of performing the following operations in case the IC-Card ID is found on the "Invalidation list".
  - Writing "Permanently voided code" on the IC-Card
  - Displaying the text "Stop" on "Stop/Go" sign board
  - Closing barrier
- In case the "IC-Card" balance is insufficient, the system shall be capable of receiving the "Warning Command" sent from "Roadside Controller" and performing the following operations:
  - Informing the Toll Collector about shortage.
  - Displaying the text "Stop" on "Stop/Go" signboard.
  - Closing Barrier.

6.4 Human Machine Interface

- The equipment components shall be capable of notifying the normal/abnormal transmission and insufficient balance to the users.
- Software shall have human machine interface to display categorized Correlated Traffic Event Data by its attribution of place or time on the screen.
- The traffic data server shall be capable of management by remote control.

6.5 Communication Interface

- The system shall provide control signal for image transmitted over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - The detailed standard of interface such as timing chart.
  - Related standards.
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

6.6 Installation

- The software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Lane Server shall be installed in air conditioned room in Toll Office.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.

- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

7. Toll Data Input Device

7.1 Functions

- Toll data input device shall be equipped for toll collector to input the vehicle class information determined by visual observation.
- Toll collector is able to determine the vehicle class information and input it into “Toll Data Input Console” based on the image displayed on the “CCTV Monitoring in Booth”.
- In case the vehicle is equipped with OBU, the system shall be capable of displaying the vehicle class information received from “Roadside Controller”.
- In case the IC-Card balance is insufficient, the system shall be capable of displaying and notifying the insufficient balance on screen.
- In case the “IC-Card” listed in “Invalidation List” is used, the system shall be capable of displaying the necessary information on screen of “Toll Data Input Device” for notifying to Toll Collector.
- The system shall be capable of reading the bar-code written in Entry Card and displaying toll fee.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The Toll Data Input Device shall have sufficient durability for 24hours a day, 365 days a year.
- The Toll Data Input Device shall have the structure which is possible to fix in the building in Toll Booth.
- The structure of Toll Data Input Device shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the Toll Data Input Device shall be capable to implement the periodical checking and clean up activities.

7.3 Performance

1) Touch & Go

- At Entry Tollgate: By operation of Toll Collector, the equipment components shall be capable of selecting the Vehicle Class that was judged by the visual observation of Toll Collector from menu on screen and transmitting it to IC-Card R/W.
- At Exit Tollgate: The equipment components shall be capable of receiving the toll fee calculated by Lane Server, based on Tollgate ID and Vehicle Class, and displaying it on screen.

2) Manual

- At entry tollgate: By operation of Toll Collector, the equipment components shall be capable of selecting the Vehicle Class that was judged by the visual observation of Toll Collector from menu on screen and transmitting it to Entry-Card Issuer..
- At entry tollgate: The equipment components shall be capable of classifying the number of Entry Card issued by Vehicle Class and Issuance Time.
- At entry tollgate: The equipment components shall be capable of transmitting the Vehicle Class and Issuance Time that mentioned on the Entry-Card to Lane Server.
- At exit tollgate: The equipment components shall be equipped with the bar-code reader for Entry-Card and capable of transmitting the information that read from bar-code such as Tollgate ID and Vehicle Class to Lane Server.
- At exit tollgate: The equipment components shall be capable of receiving the toll fee calculated by Lane Server, based on Tollgate ID and Vehicle Class, and displaying it on screen.

7.4 Human Machine Interface

- The screen shall be a touch panel type to enable keyboard and mouse input.
- OBU shall be capable of displaying the availability balance of payment, and emitting an alarm when payment balance is negative.

7.5 Communication Interface

- The system shall provide control signal for image transmitted over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - The detailed standard of interface such as timing chart.
  - Related standards.

- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

7.6 Installation

- At least one set of roadside equipment for ETC or Touch&Go or manual shall be installed at toll gates of flat rate sections.
- In the uniform milage sections, toll gates shall be constructed at all entrances and exits, and equipment for ETC odr Touch&Go or manual
- At least two setsof roadside equipment including back-up of ETC or Touvh&Go shall be installed at each entrance, exit and toll gate on the through lane.
- Roadside equipment shall be installed which block passing illegal vehicles such as those which do not pay regular fare.
- Roadside equipment such as stop signals and lane barriers shall be installed so as to arrest safely the vehicles with speed of less than 25 km/hr which are not allowed to pass.
- The software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The equipment components shall be installed in the toll booth.
- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance

8. Barrier

8.1 Functions

- Through the control from Lane Server, the lane shall be able to be closed by closing Barrier.
- By operating Barrier Switch, the lane shall be able to be closed by closing Barrier.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

8.2 Structure

- Solid barriers shall be designed to avoid damage from vehicle contact.
- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoors.
- The chassis of equipment components shall not be opened easily.
- The equipment components shall allow performing maintenance inspection from the sides and back, but not from lane direction, in order to minimize the influence on traffic flow.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.

8.3 Performance

- Through the control from Lane Server and Barrier Switch, the equipment components shall be capable of opening and closing the Barrier quickly as possible.
- The equipment components shall be equipped with the sensor for confirming whether the vehicle or something is in front of or under the Barrier or not.
- In case of the vehicle or something is in front of or under Barrier, Barrier shall be capable

of not closing to avoid crash, without considering to get a control signal from Lane Server and Barrier Switch.

- The priority order of controlling Barrier is first from Barrier Switch and second from Lane Server.

8.4 Communication Interface

- The system shall provide control signal for image transmitted over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - The detailed standard of interface such as timing chart.
  - Related standards.
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

8.5 Installation

- Barriers shall be installed so as not to interfere in construction gauge of the road.
- The equipment components shall be installed at the terminal edge of Toll Island.
- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.

9. Barrier Switch

9.1 Functions

- Barrier shall be capable of being opened and closed by using Barrier Switch. In addition, it shall be capable of displaying “Stop” on “Stop Go Sign”. (In case there is a difference between the vehicle class determined by Toll Collector and the vehicle class recorded in OBU.)
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

9.2 Structure

- The equipment component shall be operated rapidly and urgently when a vehicle is running without toll payment, therefore “Barrier Switch” shall have adequate robustness for rapid operation.
- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.

9.3 Performance

- The priority order of controlling Barrier is first from Barrier Switch and second from Lane Server.
- In case the vehicle or something is in front of or under Barrier, Barrier shall be capable of not closing to avoid crash, without considering to get a control signal from Lane Server and Barrier Switch.
- In case vehicle running in single file, the system shall be capable of notifying to Security Staff of the Toll Office by using alarm and flashing lights when the “Barrier Switch” is operated.

9.4 Human Machine Interface

- The equipment component shall be capable of operating rapidly and urgently when a vehicle bursts through the toll lane without toll payment, therefore “Barrier Switch” shall be capable of having the appropriate shape avoiding hurting the toll collector hands.

9.5 Communication Interface

- The system shall provide control signal for image transmitted over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - The detailed standard of interface such as timing chart.
  - Related standards.
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

9.6 Installation

- The equipment components shall be installed in the toll booth.
- The installation work shall include equipment component’s unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The site where the equipment component is installed shall be protected so that the general public can not access to the equipment component easily.

10. Toll Due/Paid Sign

10.1 Functions

- The equipment components shall be capable of displaying the toll amount that is calculated by Lane Server.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

10.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoors.
- The chassis of equipment components shall not be opened easily.
- The chassis of equipment components shall allow easily performing maintenance works from the sides or back, but not from lane direction, in order to minimize the influence to traffic activities.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.

10.3 Performance

- The equipment components shall be capable of receiving the toll amount that should be displayed from Lane Server.
- The equipment components shall be capable of displaying the toll amount based on the information received from Lane Server.

10.4 Human Machine Interface

- The equipment components shall be capable of allowing the driver to see and confirm the

toll amount and recognized vehicle class identification on the “Toll Due/Paid Sign” while the vehicle is passing through toll lane.

- Signals shall be installed to indicate stop signal to the drivers of the vehicles which are not allowed to pass the gate.

10.5 Communication Interface

- The system shall provide control signal for image transmitted over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - The detailed standard of interface such as timing chart.
  - Related standards.
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

10.6 Installation

- The equipment components shall be installed at the terminal edge of Toll Island.
- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The installation work shall include equipment component’s unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.

11. Stop/Go Sign

11.1 Functions

- The equipment components shall be capable of displaying “Stop” or “Go” sign following the control signal from Lane Server, .
- The equipment components shall be capable of displaying “Stop” sign following the control signal from Barrier Switch.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

11.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoors.
- The chassis of equipment components shall not be opened easily.
- The chassis of equipment components shall allow easily performing maintenance works from the sides or back, but not from lane direction, in order to minimize the influence to traffic activities.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat
- The equipment components shall be protected with measures against interference from other electronic devices.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.

11.3 Performance

- The equipment components shall be capable of receiving the control signal from Lane Server for displaying “Stop” or “Go” sign.
- The equipment components shall be capable of displaying “Stop” sign and closing Barrier when Barrier Switch is operated.
- The priority order of controlling Barrier is e first from Barrier Switch and second from Lane Server.

11.4 Human Machine Interface

- The equipment components shall be capable of allowing the driver to see and confirm the "Stop" and "Go" on the "Stop / Go Sign" while the vehicle is passing through toll lanes.

11.5 Communication Interface

- The system shall provide control signal for image transmitted over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - The detailed standard of interface such as timing chart.
  - Related standards.
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

11.6 Installation

- The equipment components shall be installed at the terminal edge of Toll Island.
- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.

12. Entry-Card Issuer

12.1 Functions

- The equipment components shall be capable of issuing the Entry-Card based on the bar-code data in Table 9. In addition, “Vehicle Class” is input from “Toll Data Input Device” by toll collector.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

12.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.

12.3 Performance

- Bar-code specification shall follow the National Standard TCVN 6755 : 2008 (ISO/IEC 15417 : 2007)
- Through the operation of Toll Collector, the equipment components shall be capable of selecting the Vehicle Class that was judged by the visual observation of Toll Collector from menu on screen and transmitting it to Entry-Card Issuer.
- After issuing Entry Card, “Vehicle Class”, “Entry Tollgate ID”, “Date and Time”, “Termination sign” can be transmitted “Lane Server”

12.4 Human Machine Interface

- After printed, the Entry Card shall be capable of being torn off by toll collector
- The equipment components shall be capable of issuing the Entry-Card.

12.5 Communication Interface

- The system shall provide control signal for image transmitted over TCP/IP.

- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - The detailed standard of interface such as timing chart.
  - Related standards.
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

12.6 Installation

- The equipment components shall be installed in the toll booth.
- The installation work shall include equipment component' s unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The site where the equipment component is installed shall be protected so that the general public can not access to the equipment component easily.

13. Classification Sign

13.1 Functions

- The equipment components shall be capable of displaying the “Vehicle class” information that was received from “Toll Data Input Device” upon the instruction from Lane Server. The “Vehicle class” is chosen and input by “Toll Collector”.
- The equipment components shall be capable of displaying the “Vehicle class” information that was received from “OBU” upon the instruction from Lane Server.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

13.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoors.
- The chassis of equipment components shall not be opened easily.
- The chassis of equipment components shall allow performing maintenance works from the sides or back, but not from lane direction, in order to minimize the influence to traffic activities.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.

13.3 Performance

- The equipment component shall be capable of receiving the Vehicle Class information to be displayed from Lane Server.
- The equipment component shall be capable of displaying the Vehicle Class based on the information that was received from Lane Server.
- The equipment component shall be capable of receiving the Toll amount information to be

displayed from Lane Server.

- The equipment component shall be capable of displaying the Toll amount based on the information that was received from Lane Server.

13.4 Human Machine Interface

- The equipment components shall be capable of allowing the driver to see and confirm the "Vehicle Class" on the "Classification Sign" while the vehicle is passing through toll lane.

13.5 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - The detailed standard of interface such as timing chart.
  - Related standards.
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

13.6 Installation

- The equipment components shall be installed at the terminal edge of Toll Island.
- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.

14. Vehicle Detector

14.1 Functions

- Measuring the number of vehicles passing through the toll lane.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

14.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoor.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment components shall allow performing maintenance works from the sides or back, but not from lane direction, in order to minimize the influence to traffic activities.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.

14.3 Performance

- The equipment components shall be capable of transmitting the measured number of vehicle. Passing through Toll lane.

14.4 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure

- The detailed standard of interface such as timing chart.
- Related standards.

- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

14.5 Installation

- The equipment components shall be installed at the terminal edge of Toll Island.
- The installation work shall include equipment component' s unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The site where the equipment component is installed shall be protected so that the general public can not access to the equipment component easily.

15. Ambient Conditions

- The equipment component shall be installed in the offices, toll booth, outside and shall be protected with measures against interferences of other electronic devices.
- The equipment component shall be capable of operating normally under the following ambient conditions:

For Main Center, Toll Management Center, and Toll Office
Temperature: 25 +/- 3 degree C in average
Relative humidity: between 20 and 80 % in average
For outside
Temperature: between - 0 and +50 degree C
Relative humidity: below 95 %

16. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- System shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for at least 30 minutes.

17. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The equipment components shall be capable of identifying the faulty parts easily in case equipment fault is detected, and the replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.
- The manufacturer of the equipment components shall make a contract for technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer shall provide the necessary services based on the contract.

18. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit a copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

19. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions:

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation:

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant

(8) After approval of the connection test procedure, the contractor will provide its own connection test and the test result shall be submitted to the road management authority and the consultant

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant.

3) Necessary Documents

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in the appropriate timing before commencement of the tests and inspections, respectively in hard copy including following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, checklist which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(16)
Road-to-Vehicle Communication

1. General Outline

This functional package allows the road operators to exchange data for toll collection and other services on the expressways by using radio communication between antennas installed at roadside and on-board units installed in the vehicles.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, for activating functional packages. The Specifications deal with the equipment components and software in-vehicle as well.

3. Relevant Regulations and Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- ITU-R M.1453: DSRC at 5.8 GHz (Physical Layer)
- ISO 15628: DSRC Applications
- ISO 14906: Application Interface Definition for DSRC
- EN 12253:2004: Road transport and traffic telemetric – Dedicated short range communication: – Physical Layer using microwave at 5.8 GHz
- EN 13372:2004: Road transport and traffic telematics (RTTT) – Dedicated short range communication – Profiles for RTTT application
- EN 15509:2007: Road transport and traffic telematics (RTTT) – Electronic fee collection interoperability application profile for DSRC

4. Requirements

- System shall be capable of transmitting the data recorded in OBU and IC-card for collecting toll and the results of processing the data.
- System shall be capable of securing an average non-stop service-time of less than 4.5 sec/vehicle.
- System shall be capable of securing undisturbed conditions despite disturbance/tapping from outside and restricting the error ratio to less than 1%.
- System shall be capable of installing roadside equipment adequately in the limited

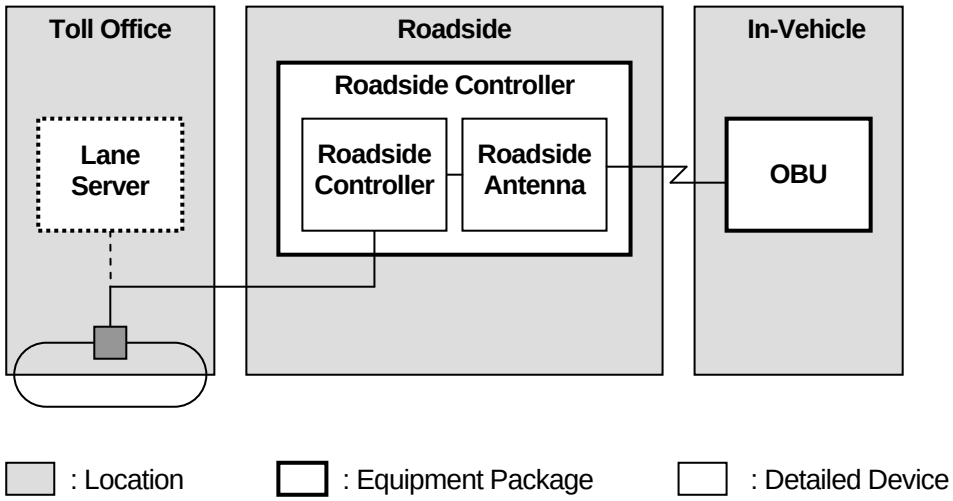
space around a tollgate lane.

- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

5. System Architecture

System architecture for road-to-vehicle communication is shown below.

Figure 5.1 System Architecture for Road-to-Vehicle Communication



6. OBU (On-Board Unit)

6.1 Functions

- 2-piece OBU and 1-piece OBU are discussed below.
- In the case of 2-piece OBU, the IC card to be installed in OBU shall be compliant with ISO/IEC 14443: Contactless Integrated Circuit Card, or ISO/IEC 18092: Near Field Communication‐Interface and protocol.
- The system shall be capable of recording the data on Contactless IC-Card, such as ID number, usage history information (date, entry and exit IC, the collected toll amount) and prepaid balance information. The stored data are shown in the table below.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The system shall communicate between with OBU and Roadside Antenna by radio communication.
- The equipment of component shall read the information of the IC card which is installed in the OBU and transmit it to Roadside Controller through the Roadside Antenna.
- The equipment of component shall read the Prepaid Balance in the IC-Card Recharge Data set of the IC card which is installed in OBU, OBU has a function to notify the driver in case the balance falls below a certain amount of money.
- The system shall comply with International Standard.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The chassis of equipment components shall not be opened easily.
- The equipment components shall be capable of being installed easily on the vehicle, where the communication between the vehicle and the Roadside Antenna is possible (for example, on the dashboard or window, etc.)
- The equipment components shall be small size in order not to hinder vision of operation after the installation.
- The equipment components shall be capable of being firmly installed to avoid being demounted easily.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with the measures against interference from other electronic devices.

6.3 Performance

- The communication between “IC-Card” with “OBU” shall be contactless.
- The information included in the card "IC-card" must be encrypted to prevent illegal modification, reading, reporting.
- Encryption method must be determined after carefully considering the distance of transmission, the encryption processing speed, the vulnerability of encryption and the encryption method of other road operators in the same road network.
- The equipment components shall be capable of promptly writing the OBU Passage Data set (shown in Table 6.3), which is saved in the OBU, into the IC-Card Passage History Data set (shown in Table 6.4) of the IC Card when the IC card is removed from OBU.

6.4 Human Machine Interface

- The equipment components shall be capable of reading the Prepaid Balance in the IC-Card Recharge Data set of the IC card which is installed in OBU. The OBU has a function to notify the driver in case the balance falls below a certain amount of money.

6.5 Communication Interface

- The system shall be capable of providing controlling signal for image transmitted over TCP/IP.
- The transmission devices shall have following communication interfaces.
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - The detailed standard of interface such as timing chart.
  - Related standards.
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

6.6 Installation

- The equipment components shall be capable of being installed easily on the vehicle where the communication between the vehicle and the Roadside Antenna is possible (for example, on the dashboard or window, etc.)
- The power of OBU basically shall rely on Internal Battery; the utilisation of Vehicle Battery is optional.

7. Roadside Antenna

7.1 Functions

- The equipment of component shall transmit and receive necessary information regarding toll collection by the radio communication between Roadside Antenna and the OBU. The transmitted and received information are shown in the table below.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The equipment components shall communicate with OBU by radio.
- The equipment components shall synchronize their clocks to the clock of “Traffic Supervising / Control Server” at start-up.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment component is installed outdoors.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with the measures against interference from other electronic devices.
- The equipment components shall be protected against dust and water ingress if it will be installed outdoors in road typical section in accordance with IP66 of the international standards IEC 60529 or equivalent.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.

7.3 Performance

- The communication zone of Roadside antenna shall range within 1.0 m to ground level 4.0 m to vehicle driving direction, 3.5 m to lane direction.
- The equipment components shall be capable of communicating with the OBU that is moving at a speed over 50 km/h.
- The equipment components shall be capable of transmitting on a specified carrier wave and the data to “OBU”.
- The equipment components shall be capable of performing data transmission control to “OBU” upon the command of “Roadside Controller”.
- The system shall comply with International Standards.
- The bit error rate (Bit Error Rate - BER) of transmission between Roadside Antenna and OBU must be less than $10^{-6.}$
- The equipment components must be capable of preparing a countermeasure for prompt and credibly transactions, such as “multiple calling”.
- The equipment components must be capable of determining the transmission error location, when it is due to system factors.
- The system must be capable of transmitting Entry Interchange Information in “OBU” for toll calculation and collect toll at the Exit tollgate.

7.4 Communication Interface

- The system shall be capable of providing controlling signal for image transmitted over TCP/IP.
- The transmission devices shall have following communication interfaces;
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

7.5 Installation

- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The software shall be capable of being installed on the operating system such as

Microsoft Windows or Linux which is widely available in many countries.

- The equipment components shall be installed near the toll booth to perform reading/writing the data from/into OBU upon the instructions of controlling device.
- The installation work shall include equipment component' s unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment component shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The site where the equipment component is installed shall be protected so that the general public can not access to the equipment component easily.

8. Roadside Controller

8.1 Functions

- The equipment components shall be capable of transmitting and receiving necessary information regarding Toll collection by the Roadside Antenna. The transmitted and received information are shown in the table below.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The equipment components shall be capable of controlling the Roadside antenna and transmitting the necessary data regarding toll collection processing from received data to Lane Server.
- The equipment components shall be capable of transmitting data relevant to toll collection by controlling command from Lane Server.
- The equipment components shall be capable of synchronizing their clocks to the clock of "Traffic Supervising / Control Server" at start-up.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

8.2 Structure

- The equipment components shall allow the user easily to perform operations with "IC-Card" when passing over the equipment component located near the toll booth.
- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment component is installed outdoors.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow performing maintenance works from its sides and/or back, but not from lane direction, in order to minimize the influence to traffic activities.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with the measures against interference from other electronic devices.

- The Roadside Controller shall have sufficient durability for 24hours a day, 365 days a year.
- The structure of Roadside Controller shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of Roadside Controller shall be capable to implement the periodical checking and clean-up activities.

8.3 Performance

- The IC-Card Reader/Writer shall be capable of performing data transmission control to “Roadside Antenna” upon the command of “Lane Server”.
- The system shall comply with International Standards.
- The bit error rate (Bit Error Rate - BER) of transmission between Roadside Antenna and OBU must be less than $10^{-6.}$
- The equipment components must prepare a countermeasure for prompt and credibly transactions, such as “multiple calling”.
- The equipment components must be capable of determining the transmission error location, when due to system factors.
- The system must be capable of transmitting Entry Interchange Information in “OBU” for toll calculation and collect toll at the Exit tollgate.

8.4 Communication Interface

- The system shall be capable of providing controlling signal for image transmitted over TCP/IP.
- The transmission devices shall have following communication interfaces;
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

8.5 Installation

- The software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The equipment components shall be installed near the toll booth to perform

reading/writing the data from/to Roadside Antenna upon the instructions of controlling device.

- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

9. Ambient Conditions

- The equipment components shall be installed in the offices, toll booth, outside and shall be protected from interferences of other electronic devices.
- The equipment component shall be capable of operating normally under the following ambient conditions:

For Main Center, Toll Management Center, and Toll Office
Temperature: 25 +/- 3 degree C in average
Relative humidity: between 20 and 80 % in average
For outside
Temperature: between - 0 and +50 degree C
Relative humidity: below 95 %

10. Power supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- System shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for at least 30 minutes.

11. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The equipment components shall be capable of identifying faulty parts easily in case a fault is detected, and the replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.
- The manufacturer of the equipment components shall make a contract for technical support of operation and maintenance related to the delivered equipment components with the road management authority. The manufacturer shall provide the necessary services based on the contract.

12. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit a copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

13. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions;

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant.

3) Necessary Documents

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(17)
IC-Card Recording

1. General Outline

This functional package allows the road operators to deduct prepaid balance of IC-cards for collecting toll by using equipment installed at tollgates on the expressways.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, for activating functional packages. This Specification deals with the equipment components as well as software for mobile use.

3. Relevant Regulations and Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11169: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- ISO/IEC 14443: Contactless Integrated Circuit Cards
- ISO/IEC 18092: Near Field Communication – Interface and protocol

4. Requirements

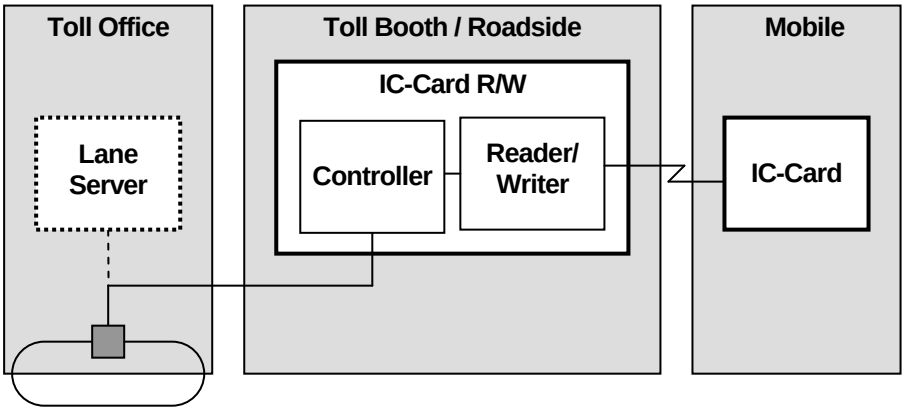
- System shall be capable of notifying the data for collecting toll and the results of processing the data.
- System shall be capable of allowing to secure an average service-time by one-stop collection of less than 9.0 sec/vehicle.

  (*Average service-time is the duration from when one car halts behind another which is stopping for departure toll collection until the car departs after the collection finishes)
- System shall be capable of making the payment promptly and credibly, without being disturbed by outside noise or eavesdropping.
- System shall be capable of allowing prepayment and storing prepaid balance in the IC-card.
- System shall be capable of allowing installing roadside equipment adequately in the limited space around a tollgate lane.
- System shall be capable of allowing securing sufficient durability and reliability of equipment components in the ambient conditions at installation site on roadside.

5. System Architecture

System architecture for IC-card recording is shown below.

Figure 5.1 System Architecture for IC-card Recording



: Location : Equipment Package : Detailed Device

Broken Lines: Outside of This Functional Package

6. IC-Card

6.1 Functions

- To record the data on Contactless IC-Card, such as ID number, usage history information (date, entry and exit IC, the collected toll amount) and prepaid balance information. The stored data set is shown in the table below.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- "IC-Card" shall be capable of storing up to 10 records of toll collection history.
- Data transmission method shall be based on ISO / IEC 14443: contactless Integrated Circuit Cards, or the Standard ISO / IEC 18092: Near Field Communication - Interface and protocol.

6.2 Structure

- Shape of the "IC-Card" shall be based on ISO / IEC 14443 standards: contactless Integrated Circuit Cards.

6.3 Performance

- The communication between "IC-Card" with "IC-Card Reader/Writer" shall be contactless.
- In case "Invalid IC Card ID" is indicated on "Invalidation-list", the "IC-Card" shall have a flag written in "Permanently voided code" to be a permanently unusable card when the card is attempted to be used.
- The information included in the card "IC-card" must be encrypted to prevent illegal modification, reading or reporting.
- Encryption method shall be determined on the basis of carefully considering the distance of transmission, the encryption processing speed, the vulnerability of encryption and the encryption of other road operators in the same road network.

6.4 Human Machine Interface

- To allow the IC-card be identified by visual observation, the following items shall be written on the front side or backside of IC-Card:
  - Issuing date (front side)
  - Valid date (front side)
  - IC-Card ID (front side)
  - Name of Holder (front side)
  - Issuing Agency Name (back side)
  - Issuing Agency Address (back side)

- Sign holder's name(back side)
- Other remarks (back side)

6.5 Communication Interface

- The system shall have communication interface from "IC-Card" to "IC-Card Reader/ Writer" as shown in the table below.

Table 6.3 Communication interface from "IC-Card" to "IC-Card Reader/Writer"

Item	Specifications
Encoding method	NRZ-L or Manchester or Modified Miller
Initial transmission rate	> 105kbit/s

- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

7. IC-Card R/W (Reader/Writer)

7.1 Functions

- "IC-Card Reader/Writer" shall be capable of reading the data stored in "IC-Card" and transmitting the data to "Lane Server". The stored data sets are shown in the tables below.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- "IC-Card Reader/Writer" shall be capable of writing the data controlled by "Lane Server".
- "IC-Card Reader / Writer" shall be capable of reading the toll collection history data stored in "IC-Card" .
- The equipment components shall be capable of writing the toll collection history data up to 10 records. In case of the history data is above 10 records, oldest record is deleted then newest data is added.
- The equipment components shall be capable of communicating with IC cards by radio communication.
- The equipment components shall be capable of synchronizing its clock to the clock of "Traffic Supervising / Control Server" at start-up.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

7.2 Structure

- The equipment components shall be capable of allowing the user to easily perform operations with "IC-Card" when passing over the equipment component that located near the toll booth.
- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment component is installed outdoors.
- The equipment components shall be protected against dust and water ingress if it will be installed outdoors in road typical section in accordance with IP66 of the international standards IEC 60529 or equivalent.

- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow performing maintenance works from the sides and/or back, but not from lane direction, in order to minimize the influence to traffic activities.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.

7.3 Performance

- The communication between “IC-Card” with “IC-Card Reader/Writer” shall be contactless.
- The IC-Card Reader/Writer shall be capable of transmitting specified carrier wave, power and data to “IC-card”.
- The IC-Card Reader/Writer shall be capable of capturing the change of magnetic flux from “IC-Card” for receiving data.
- The IC-Card Reader/Writer shall be capable of performing data transmission control to “IC-Card” upon the command of “Lane Server”.
- Data transmission method shall be carried out based on ISO / IEC 14443: contactless Integrated Circuit Cards, or the Standard ISO / IEC 18092: Near Field Communication - Interface and protocol.
- The bit error rate (Bit Error Rate - BER) probability of transmission between IC-Card R/W and IC-Card, must be less than $10^{-6.}$
- The equipment components shall be capable of preparing a countermeasure for prompt and credible transaction, such as “multiple calling”.
- The equipment component shall be capable of determining the place of transmission error, when it occurs due to factors of the system.
- The system shall be capable of transmitting the Entry Interchange Information in “IC-Card” for toll calculation and collect toll at the Exit tollgate, using the Entry Interchange Information.
- The system shall be capable of diagnosing whether the writing is done credibly or not when the Entry Interchange Information is not written in “IC-Card”.
- The system shall be capable of confirmation “Prepaid balance” and “Termination flag” in “IC-Card”. In case “Prepaid balance” is insufficient, it will notify the driver and send “Warning command” to “Lane Server”.
- The system shall be capable of writing Remark on "Termination flag" in "IC-card". This remark helps to determine whether the transmission (writing Entry Interchange

information, toll collection transaction, recharge transaction) was done correctly or not at the Entry Interchange or Exit Interchange.

- The IC-Card Reader / Writer shall be capable of checking whether the most recent transmission was done at Entry Interchange or Exit Interchange by using ""Termination flag" of "IC-card".
- The system shall be capable of writing the number of transmission (the same as number of passing tollgates) in “Transaction counter” of “IC-Card” for the diagnosis whether the "IC-card" is counterfeit and whether written information is completed or not in the "IC-card".
- The system shall be capable of performing the following activities if the IC-Card ID is found on the “Invalidation list”:
  - Writing “Permanently voided code” in the IC-Card
  - Displaying the text “Stop” on “Stop/Go” sign board
  - Closing “Barrier”
- The “IC-Card Reader / Writer” shall be capable of reading "Permanently voided code" in the "IC-card” and checking whether the card is permanently unusable or not. In case of the card is permanently unusable, the following operations shall be done;
  - Displaying the text “Stop” on “Stop/Go” sign board
  - Closing “Barrier”
- The equipment components shall be capable of demodulating carrier wave’s change of magnetic flux from “IC-Card” for receiving the data. This transaction shall be in compliance with standards of ISO / IEC 14443 or ISO/IEC 18092. The major specifications shall be as follows:
  - The carrier frequency shall be 13.56 MHz.
  - The operating range from the antenna center to all directions must be at least $\pm$30 mm on X-axis, $\pm$30 mm on Y-axis, 50 mm on Z-axis. However, in consideration of the way of holding the card, the operating range should be as large as possible.

7.4 Human Machine Interface

- The equipment components shall be capable of notifying normal/abnormal and insufficient prepaid balance on “IC Card” to the users.

7.5 Communication Interface

- The system shall have communication interface from “IC-Card Reader/Writer” to “IC-Card” as shown in the table below.

Table 7.6 Communication Interface between “IC-Card Reader/Writer” and “IC-Card”

Item	Specifications
Main carrier wave	13.56MH z
Modulation method	ASK
Encoding method	NRZ-L or Manchester or Modified Miller
Operation range	Refer to Figure 1

- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

7.6 Installation

- The software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The equipment components shall be installed near the toll booth to perform reading/writing the data from/into Contact-less IC card upon the instructions of controlling device.
- At Touch and Go Lane, Contactless IC Card Reader / Writer (ICC R/W) are installed at Touch and Go lane. The ICC R/W are attached on the outside wall of toll booth, it is installed three height according to the height of driver seat.
- At ETC Lane, Contactless IC Card Reader / Writer (ICC R/W) are installed at Toll booth for the trouble of ETC communication.

8. Ambient Conditions

- The equipment components shall be installed in the offices, toll booth, outside and shall be protected with measures against interference from other electronic devices.
- The equipment component shall be capable of operating normally under the following ambient conditions:

For Main Center, Toll Management Center, and Toll Office

Temperature: 25 +/- 3 degree C in average
Relative humidity: between 20 and 80 % in average

For outside

Temperature: between - 0 and +50 degree C
Relative humidity: below 95 %

9. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- System shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for at least 30 minutes.

10. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The equipment components shall be capable of identifying the faulty parts easily in case a fault is detected, and the replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.
- The manufacturer of the equipment components shall make a contract for technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer shall provide the necessary services based on the contract.

11. Quality Control

- The manufacturer of the equipment components shall have ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit a copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

12. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions:

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall at least include the inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation:

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant.

3) Necessary Documents

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in the appropriate timing before commencement of the tests and inspections, respectively in hard copy including the following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, checklist which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project.

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(18)
Toll Data Management

1. General Outline

This functional package allows the road operators to keep all data of toll collection, to manage the Invalidation list on the usage of on-board units and IC-cards, and to manage toll revenue of the expressways with a high reliability by using computers and software

2. Scope

Draft General Specifications deal with the equipment components and software to be installed in toll offices and the toll management centres of the expressway network for actualizing functional packages.

3. Relevant Regulations and Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- ISO/CD 24533: Data directory and Message set for tracking of freight and It's intermodal transfer

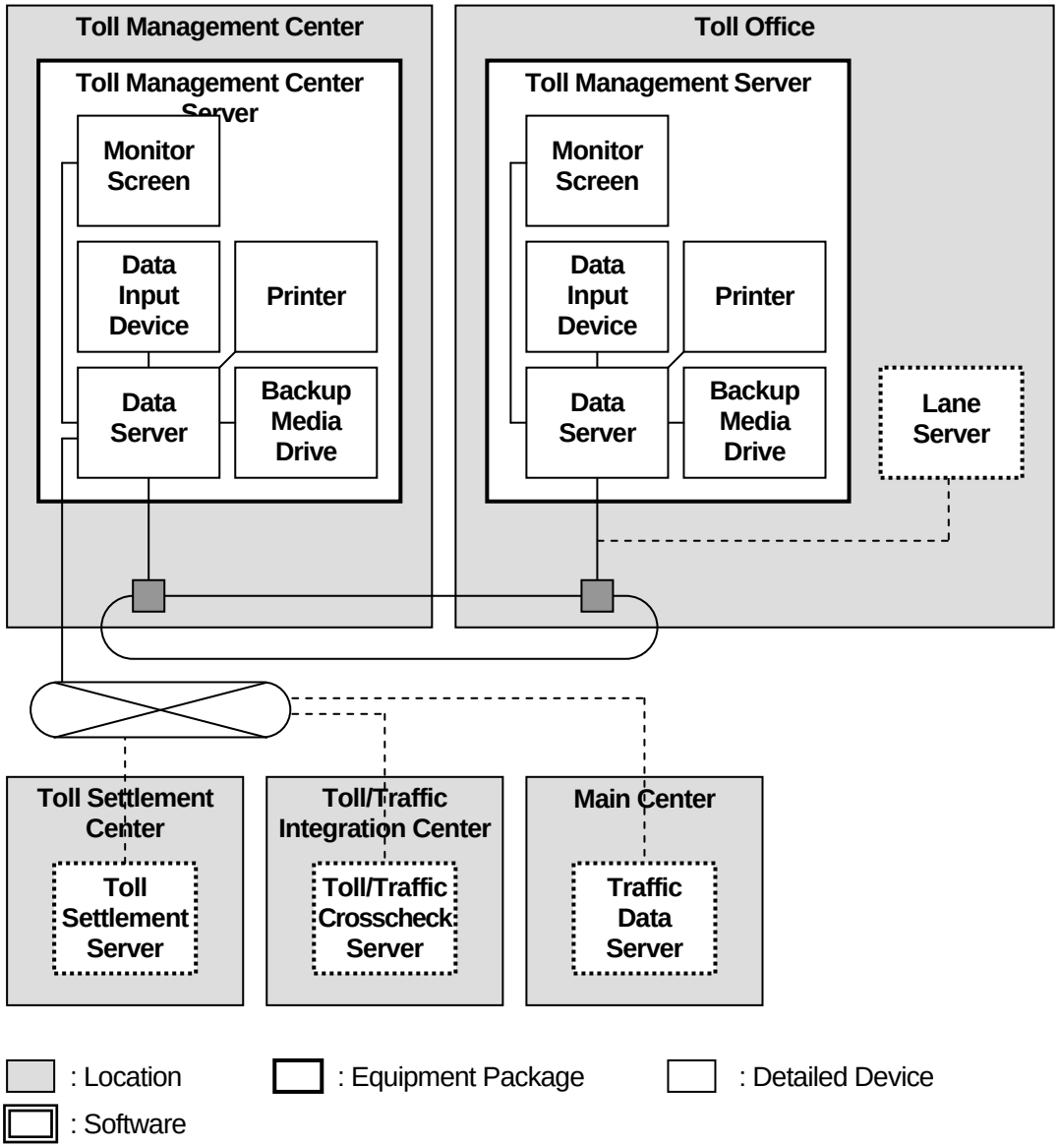
4. Requirements

- System shall be capable of storing all transaction data between OBU and roadside equipment for toll collection in a database.
- System shall be capable of generating the data of forms for toll management and storing them in a database.
- System shall be capable of functioning 24 hours a day, 365 days a year by having a redundant system with sufficient durability/reliability of equipment components.

5. System Architecture

System architecture for toll data management is shown below.

Figure 5.1 System Architecture for Toll Data Management



6. Toll Management Center Server

6.1 Functions

- To receive, compile and manage the Transaction data, Toll collection data relating to toll collection from Toll Management Server from each Tollgate.
- To receive the related information of enforcements (such as crackdown of fraud) from subordinate equipment.
- To detect a vehicle which is suspected of fraud from Enforcement Data Set
- To compose the Invalidation list based on the information which is transmitted from each Toll Settlement Server such as Lost IC-Card and Suspended IC-Card; and the information which is transmitted from each OBU Management Server such as Lost OBU and Suspended OBU.
- To store all Transaction data and Toll collection data related to toll collection. The required retention period of the data is shown in Table 6.3.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with measures against interference from other electronic devices.

6.3 Performance

- The system shall be capable of calculating toll amount by the items mentioned in the Table 6.1 for the road section under management scope of each toll office based on Daily Transaction data and Toll Collection Data which are sent from “Toll Management Server” located at each “Toll Office”
- The system shall be capable of calculating toll amount and traffic volume classifying by each vehicle class and by each IC card ID as mentioned in Table 6.1, upon vehicle classification policy of the Ministry of Finance.
- The system shall be capable of compiling statistical data and making reports: daily report,

weekly report, monthly report, and yearly report.

- The system shall be capable of transmitting the statistical data including transaction data and toll collection data to "Toll Clearance Server" at "Toll Settlement Center"
- The system shall be capable of transmitting the statistical data including transaction data and toll collection data to "Toll/Traffic Crosscheck Server" at "Toll/Traffic Integration Center"
- The system shall be capable of transmitting the Transaction data and Toll collection data to "Toll Clearance Server" at "Toll Settlement Center"
- The system shall be capable of transmitting the Transaction data, Toll collection data to "Toll/Traffic Crosscheck Server" at "Toll/Traffic Integration Center"
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The system shall be capable of transmitting the Traffic volume data (through the tollgate) to "Toll/Traffic Crosscheck Server" which is located at "Toll/Traffic Integration Center".
- The system shall be capable of allowing to receive the "Invalidation-list" of the IDs of stolen and/or suspended OBUs or IC cards from Toll Clearance Server which is located at Toll Settlement Centre.
- The system shall be capable of sending the "Invalidation-list" to "Toll Management Server"
- The system shall be capable of storing all Transaction data and Toll collection data related to toll collection.
- The equipment component shall be capable of retrieving and displaying the transaction records which are stored Transaction Data and Toll Collection data by using retrieve condition elements which are input by using "Data Input Device".
- Stored Transaction data and Toll collection data shall be backed up.
- The system shall be capable of receiving "OBU Registration data" from "OBU Registration Terminal".
- The system shall be capable of updating according to received "OBU Registration data" and backing-up "OBU Registration data".
- The following backups shall be performed as part of system backup.

  (1) Continuous data protection backup: Backup is to restore HDD of Data Server when it crashes, using system such as RAID.

  (2) Full + Incremental backup: Backup is to restore data in the case of data loss on Data Server. Full backup is making a copy of all data in Data Server then stored in another HDD on a monthly basis and incremental backup is making daily back up of the changes as compared to the backup the day before.

(3) Full System backup covers copy and storage of all software and data of Toll Management Center Server.

- The system shall be capable of extracting necessary information from Transaction Data and Toll collection data stored in Data Server based on search criteria which is input from Data Input Device, then displaying it on the Monitor Screen. The minimum search criteria are as follows:
  - IC-Card ID
  - OBU ID
  - ID of Toll gate
  - ID of Toll lane
  - Name of toll gate
  - Vehicle information (such as Vehicle class, Number Plate and etc)
  - Date and time
- The system shall be capable of displaying the retrieved results on the monitor screen.
- The system shall be capable of printing information which is displayed on Monitor Screen.
- Recommended size of monitor screen shall be (approx.) 20 inches or over.
- All consoles shall have user-friendly interface.
- The system shall be capable of printing retrieved results by A4/A3 type printer.
- The equipment component shall be capable of saving the compiled data in CSV format. It shall be capable of being accessed and modified using commercially application software (such as Microsoft Excel).
- The Banking Data Input Console shall be installed separately in Main Center for the transmission of billing data to the Toll Settlement Server.
- Toll Management Server and Banking Data Input Device shall be equipped with Removable Storage Device for offline inputting the billing data into the Banking Data Input console in order to maintain banking security.
- System should have Uninterruptible Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

6.4 Human Machine Interface

- The equipment components shall have human machine interface for “Operator” to input searching conditions to retrieve the “Transaction data” and “Toll collection data” and for adding and adjusting “Invalidation List”.

6.5 Communication Interface

- The system shall provide control signal for image transmitted over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation which needed for transmission designing of between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the interface standards
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

6.6 Installation

- Software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.

7. Toll Management Server

7.1 Functions

- The equipment components shall be capable of receiving, compiling and managing the Transaction data and Toll collection data relating to toll collection from Lane Server from each Tollgate.
- The equipment components shall be capable of receiving the related information of enforcements (such as crackdown of fraud) from subordinate equipment.
- The equipment components shall be capable of detecting a vehicle which is suspected of fraud from Enforcement Data Set
- The equipment components shall be capable of receiving the invalidation list from Toll Management Center Server, and then the invalidation list shall be transmitted to Lane Server.
- The system shall be capable of storing all Transaction data and Toll collection data related to toll collection.
- The system shall be capable of synchronizing its clock to the clock of “Toll Management Center Server” at start-up. After clock synchronization, the system shall be capable of picking out required information from the database in the “Data Server”
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices.

7.3 Performance

- System shall be capable of storing all Transaction data and Toll collection data related to toll collection. Necessary storage period is shown in Table 7.1.
- The system shall be capable of transmitting the Transaction data and Toll collection data to “Toll Management Center Server” which is located at “Toll Management Center”.

- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The system shall be capable of receiving “Invalidation-list” which is recorded by ID such as stolen OBU or IC Card, from Toll Settlement Server which is located at Settlement Centre.
- The system shall be capable of recording "Invalidation-list" on the Data Server, and sending it to the "Lane Server".
- The system shall be capable of retrieving and displaying the transaction records from which are stored on the database (such as Transaction Data, Toll Collection data) by using retrieve condition elements which are input using “Data Input Device”.
- Stored Transaction data and Toll collection data shall be backed up.
- The system shall be capable of receiving “OBU Registration data” from “Toll Management Center Server”
- The system shall be capable of updating according to received “OBU Registration data” and backing-up “OBU Registration data”.
- The system shall be capable of receiving and storing “Toll rate table” sent by “Toll Management Center Server”
- The system shall be capable of receiving and storing “Toll rate table” sent by “Toll Management Center Server”
- The equipment of component shall be capable to transmit the image of vehicle license number plate to “Image Recognition Processor”.
- The equipment of component shall be capable to accumulate enforcement information (including image) in the database shown in the table below.
- Capacity of accumulation shall be sufficient for at least 50,000 vehicles / day for 12 months.
- The system shall be capable of displaying extracted information from the target accumulated image data and recognition results after inputting search conditions, The minimum search conditions are as follows:
  - Tollgate ID
  - Lane Serve ID
  - Licence number (fuzzy reference)
  - OBU ID
  - Date and time of get images
- The equipment components shall be capable of displaying a list of the Vehicle/OBU with License number of each vehicle stored in OBU for comparing with License number scanned by scanner.
- The following backups shall be performed as part of system backup:

(1) Continuous data protection backup: Backup is to restore HDD of Data Server when it crashes, using system such as RAID

(2) Full + Incremental backup: Backup is to restore data in the case of data loss on Data Server. Full backup is making a copy of all data in Data Server then stored in another HDD on a monthly basis and incremental backup is making daily back up of the changes as compared to the backup the day before.

(3) Full System backup covers copy and storage of all software and data of Toll Management Server.

- The system shall be capable of extracting necessary information from Transaction Data and Toll collection data stored in Data Server based on search criteria which is input from Data Input Device, then displaying it on the Monitor Screen. The minimum search criteria are as follows:
  - IC-Card ID
  - OBU ID
  - ID of Toll gate
  - ID of Toll lane
  - Name of toll gate
  - Vehicle information (such as Vehicle class, Number Plate and etc)
  - Date and time
- The system shall be capable of displaying the retrieved results on the monitor screen.
- The system shall be capable of printing information which is displayed on Monitor Screen.
- Recommended size of monitor screen shall be (approx.) 20 inches or over.
- All consoles shall have user-friendly interface.
- The system shall be capable of printing retrieved results by A4/A3 type printer.
- The equipment component shall be capable of saving the compiled data in CSV format. It shall be capable of being accessed and modified using commercially application software (such as Microsoft Excel).
- System should have Uninterruptible Power Supply (UPS) against power failure UPS must be capable of providing power for the system for more than 2 hours.

7.4 Human Machine Interface

- The equipment components shall have human machine interface for “Operator” to input searching conditions for retrieve the “Transaction data” and “Toll collection data” and for adding and adjusting “Invalidation List”.

7.5 Communication Interface

- The system shall provide control signal for image transmitted over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation which needed for transmission designing of between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the interface standards
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

7.6 Installation

- Software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.

8. Ambient Conditions

- The equipment component shall be installed in the offices, toll booth, outside and shall be protected from interference of other electronic devices.
- The equipment component shall be capable of normally operating under the following ambient conditions:

For Main Center, Toll Management Center, and Toll Office
Temperature: 25 +/- 3 degree C in average
Relative humidity: between 20 and 80 % in average
For outside
Temperature: between - 0 and +50 degree C
Relative humidity: below 95 % in average

9. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- System shall have Uninterrupted Power Supply (UPS) to against power failure. UPS must be capable of providing power for the system for more than 2 hours.

10. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The equipment components shall be capable of identifying the faulty parts easily in case a fault is detected, and the replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.
- The manufacturer of the equipment components shall make a contract for technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer shall provide the necessary services based on the contract.

11. Quality Control

- The manufacturer of the equipment components shall have ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit the copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

12. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions:

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests, The factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation:

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant.

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant.

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant.

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in the appropriate timing before commencement of the tests and inspections, respectively in hard copy including following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project.

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(19)
OBU Management

1. General Outline

This functional package allows to registrant on-board units by using equipment installed in OBU issue office, and allows to generate/manage the registration list and the negative list of on-board units by using computers and software installed in the OBU registration center.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed in OBU set-up service shops for actualizing functional packages. This Specifications deal with the equipment components as well as software to be installed in the OBU registration center.

3. Relevant Regulations and Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- ITU-R M.1453: DSRC at 5.8GHz (Physical Layer)
- ISO 15628: DSRC Applications
- ISO 14906: Application Interface Definition for DSRC
- EN 12253:2004: Road transport and traffic telematics – Dedicated short range communication: – Physical Layer using microwave at 5.8 GHz
- EN 13372:2004: Road transport and traffic telematics (RTTT) – Dedicated short range communication – Profiles for RTTT application
- EN 15509:2007: Road transport and traffic telematics (RTTT) – Electronic fee collection interoperability application profile for DSRC
- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sector – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- ISO/IEC 14443: Contactless Integrated Circuit Cards
- ISO/IEC 18092: Near Field Communication – Interface and protocol

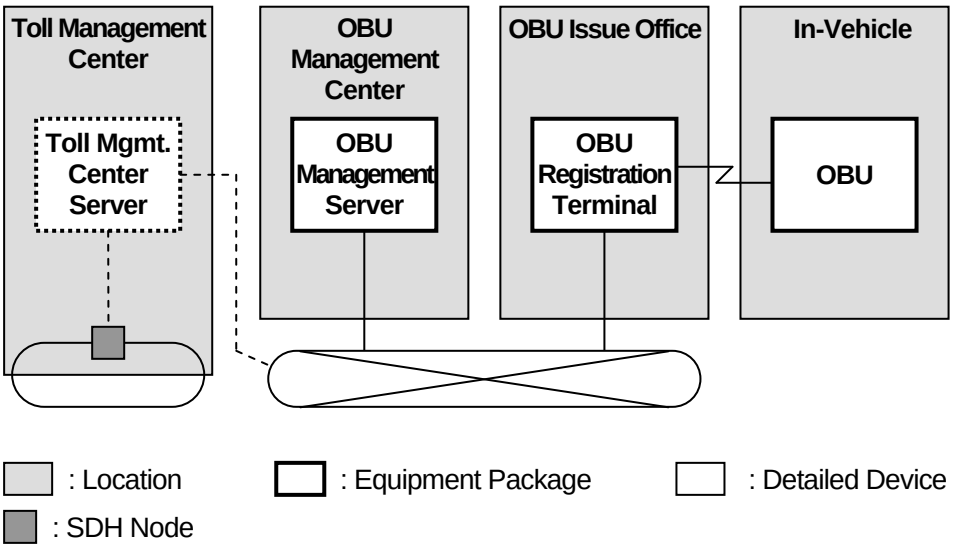
4. Requirements

- System shall be capable of writing the information (such as OBU ID, Date of issue, License number, Vehicle class) of a vehicle which is equipped with OBU.
- System shall be capable of writing the information credibly and securely when it is written into OBU.
- System shall be capable of providing a unique ID for any OBU which is registered any place in the country.
- System shall be capable of transmitting the OBU ID which is registered, to Toll Management Server of each Road operator.

5. System Architecture

System architecture for OBU management is shown below.

Figure 5.1 System Architecture for OBU Management



6. OBU (On-Board Unit)

6.1 Functions

- In the case of 2-piece OBU, the IC card to be installed in OBU shall be compliant with ISO/IEC 14443: Contactless Integrated Circuit Card, or ISO/IEC 18092: Near Field Communication – Interface and protocol.
- The OBU shall be capable of recording the data on Contactless IC-Card, such as ID number, usage history information (date, entry and exit IC, the collected toll amount) and prepaid balance information.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The system shall be capable of communicating between with OBU and OBU Registration Terminal by radio communication or Contactless IC-Card.
- The equipment of component shall be capable of reading the Prepaid Balance in the IC-Card Recharge Data set of the IC card which is installed in OBU, OBU has the function of telling when the balance falls below a certain amount of money.
- The system shall be capable of complying with International Standards.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment component shall be capable of being installed easily in the vehicle where the communication between the vehicle and the Roadside Antenna is possible, for example, on the dashboard or window, etc.
- The equipment component shall have small size in order not to hinder vision of the operation,
- The equipment component shall be capable of being firmly installed to avoid being demounted easily.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment and radiant solar heat
- The equipment components shall be protected with measures against interference from other electronic devices.

6.3 Performance

- The communication between “IC-Card” with “OBU” shall be contactless.
- The information included in the card "IC-card" must be encrypted to prevent illegal modification, reading or reporting.
- Encryption method shall be determined carefully by considering the distance of transmission, the encryption processing speed, the vulnerability of encryption and the encryption of other road operators in the same road network.
- The equipment of component shall be capable of recording the OBU Registration Data set in the non-volatility memory of OBU.
- The data written into OBU shall be encrypted against illegal reading and writing.
- The equipment components shall be capable of operating normally under the ambient conditions shown in the table below.

Table 6.2 Temperature range, operating

	Temperature	Relative Humidity
In Vehicle	-25 degrees C < < +85 degrees C	Average < 95 %

6.4 Human Machine Interface

- The equipment of component shall be capable of reading the Prepaid Balance in the IC-Card Recharge Data set of the IC card which is installed in OBU, OBU shall have the function of telling when the balance falls below a certain amount of money.

6.5 Communication Interface

- The system shall provide control signal for image transmitted over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - The detailed standard of interface such as timing chart.
  - Related standards.
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

6.6 Installation

- The equipment of components shall be capable of being installed easily in an appropriate position in vehicle where the communication between the vehicle and the Roadside Antenna is possible, for example, on the dashboard or window, etc.
- The power of OBU shall basically rely on Internal Battery. The utilisation of Vehicle Battery is optional.

7. OBU Registration Terminal

7.1 Functions

- The equipment components shall be capable of providing a unique ID for any OBU which is registered any place in the country.
- The equipment components shall be capable of inputting the information of Vehicle (such as height, length, number of axles, capacity of passengers, weight, loading capacity and etc.) and recording them in the database.
- The equipment components shall be capable of outputting and displaying the Vehicle class, which is identified in accordance with Vehicle Classification for toll collection of Ministry of Finance.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices.

7.3 Performance

- The equipment component shall be capable of requesting the OBU ID issuance to “OBU Management Server” at the time of initial OBU registration.
- The equipment component shall be capable of receiving the OBU ID from “OBU Management Server” which responds and transmits it for the request of OBU ID issue.
- The equipment component shall be capable of transmitting the OBU ID which is registered, to Toll Management Server of each Road operator.
- The equipment component shall be capable of writing the information (such as OBU ID, Date of issue, License number, Vehicle class) of the vehicle which is equipped with OBU.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard

(as well as drawings for design).

- The equipment component shall be capable of making encryption of the OBU Registration Data set when it is written into the OBU.
- The equipment component shall be capable of communicating between with OBU and OBU Registration Terminal by radio communication or Contactless IC-Card.
- The equipment component shall be capable of transmitting the registered OBU Registration Data set, information of the Vehicle and User's information to "OBU Management Server".

7.4 Human Machine Interface

- The equipment component shall have human machine interface for displaying and inputting information.

7.5 Communication Interface

- The system shall provide control signal for image transmitted over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

7.6 Installation

- The software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.

8. OBU Management Server

8.1 Functions

- The equipment component shall be capable of recording the OBU ID which is registered any place in the country.
- The equipment component shall be capable of indicating unique OBU ID for checking registered OBU ID.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment components shall be capable of dissipating temperature rising from inside equipment .
- The equipment components shall be protected with measures against interference from other electronic devices.

8.3 Performance

- The equipment component shall be capable of transmitting a unique OBU ID for the request of OBU ID issue from “OBU Registration Terminal”.
- The equipment component shall be capable of receiving the registered OBU Registration Data set, information of the Vehicle and User’s information from “OBU Management Server”.
- Data elements and their attributes, including the use case of exchanging messages, shall be in conformity with the data dictionary shown in the Draft ITS Message/Data Standard (as well as drawings for design).
- The equipment components shall be capable of recording the OBU Registration Data set, with information of Vehicle and User’s information in the database.
- The equipment components shall absolutely avoid issuing duplication of OBU ID.
- The equipment components shall be capable of retrieving the relevant information from the database.
- The equipment components shall be capable of printing and displaying the retrieved information.

8.4 Human Machine Interface

- The equipment components shall have human machine interface for displaying and inputting information.

8.5 Communication Interface

- The system shall control transmitting the signal for image over TCP/IP.
- The transmission devices shall have the following communication interfaces:
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be disclosed in order to secure the interoperability of devices.

8.6 Installation

- The software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.

9. Ambient Conditions

- The equipment component shall be installed in the offices, toll booth, outside and shall be protected from interference of other electronic devices.
- The equipment component shall be capable of operating normally under the following ambient conditions:

For Main Center, Toll Management Center, and Toll Office
Temperature: 25 +/- 3 degree C in average
Relative humidity: between 20 and 80 % in average
For outside
Temperature: between - 0 and +50 degree C
Relative humidity: below 95 % in average

10. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

11. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The equipment components shall be capable of identifying the faulty parts easily in case it is detected, and the replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.
- The manufacturer of the equipment components shall make a contract for technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer shall provide the necessary services based on the contract.

12. Quality Control

- The manufacturer of the equipment components shall have ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit the copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

13. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions;

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests, The factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation:

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant.

(8) After approval of the connection test procedure, the contractor will provide its own connection test and the test result shall be submitted to the road management authority and the consultant.

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant.

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in the appropriate timing before commencement of the tests and inspections, respectively in hard copy including the following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, checklist which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

Al least the following conditions shall be determined in each project.

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(20)
Axle Load Measurement

1. General Outline

This functional package allows the road operators to detect/regulate overloaded heavy trucks on the expressways by using axle load scale installed in the exit tollgate lane exclusive for large-size vehicles.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, for actualizing functional packages.

3. Relevant Regulations and Standards

1) International Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sensor – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries

2) National Standards

- Circular 07/2010/TT-BGTVT: Legal regulation for measurement of overloaded heavy truck
- Decree No. 34/2010/ND-CP: Processing for measured overload heavy truck
- TCVN 4054
- TCVN 5729

4. Requirements

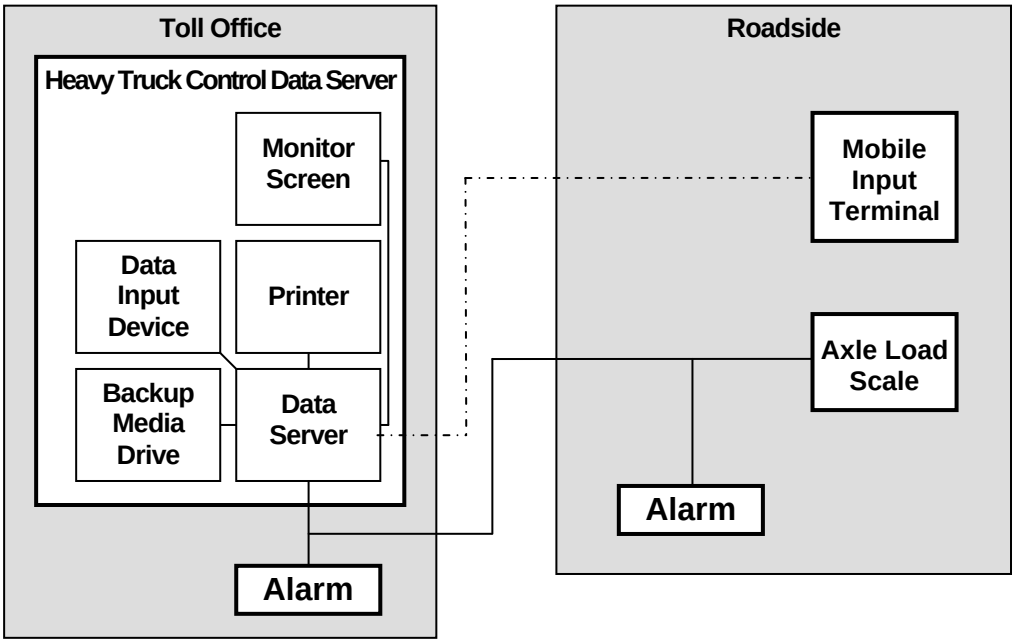
- System shall be capable of measuring the number of axles and axle loads of vehicles in motion and investigating overloading.
- System shall be capable of notifying the detection of overloaded vehicle to the operator.
- System shall be capable of generating/storing identification data of overloaded vehicles.
- System shall be capable of showing and printing out the needed results.
- System shall be capable of allowing installing roadside equipment adequately in a tollgate lane and a dedicated space.

- System shall be capable of allowing securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

5. System Architecture

System architecture for Axle Load Measurement is shown below.

Figure 5.1 System Architecture for Axle Load Measurement



: Location : Equipment Package : Detailed Device

: Software

Broken Lines: Outside of This Functional Package

6. Axle Load Scale

6.1 Functions

- Axle load scale equipment components have axle load measurement function and roadside processing function such as data logger.
- The axle load measurement equipment components measure axle weight and number of axles when a heavy truck passes through the axle load measurement system zone without stopping. (Weigh–in–Motion) The equipment is installed close to the back of the expressway entrance tollgate and is dedicated for heavy trucks. The toll island extends up to the starting point of the measurement zone.
- The axle load measurement equipment components and vehicle detector will be synchronized and the measurement result shall be matched with the heavy truck photo taken during axle load measurement.
- The axle load measurement equipment components shall be capable to detect and identify failure of equipment components whenever it happens.
- Roadside processing function shall be capable to collect measured axle load raw data and vehicle detection result, and capable to process such data.
- Roadside processing function shall be capable to link converted measured result of axle load and vehicle detection data, including identifying number of axles, for each heavy truck.
- Roadside processing function shall be capable to store processed data for at least two (2) hours.
- Roadside processing function shall be capable to transmit the data in response to the transmitting request from the Heavy Truck Control Data Server.
- Roadside processing function shall be capable to add specific code such as “999” to indicate “unknown” if received data is definitely out of range.
- The equipment components for roadside processing function shall be capable to detect and identify failure of equipment components whenever it happens

6.2 Structure

- The equipment components shall have adequate structure, shape, size, and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoor.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.

- The equipment components shall allow performing maintenance works from its sides and/or back, but not from lane direction, in order to minimize the influence to traffic ativities.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The structure of axle load scale and related equipment component such as connecting cables shall be capable to withstand natural conditions, meteorological conditions, electromagnetic noise, and other environmental conditions in Vietnam.

6.3 Performance

- The axle load measurement equipment components shall be capable of:
  - measuring up to 20 tons
  - at under 40 km/h heavy truck driving speed
  - within accuracy of 10% for 95% of the measured results.
- The above accuracy does not include the error due to road surface indentation made by truck.
- Roadside processing function shall complete its processing and issuing alert of overloading within the time of the heavy truck's passing through the axle road measurement system zone, including the processing time of Heavy Truck Control Data Server.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

6.4 Human Machine Interfaces

- The operation conditions of axle load measurement equipment components shall be capable to be checked by the roadside processing function such as data logger to be connected to the measurement equipment components. The roadside equipment component shall be equipped with necessary Human Machine Interface.

6.5 Communication Interfaces

- The data transmission between roadside processing function such as data logger and Heavy Truck Control Data Server shall be made over TCP/IP.
- Communication interfaces shall be properly selected to function well during data and signal transmission between axle load measurement equipment components and roadside processing function such as data logger.
- The roadside processing function such as data logger shall be equipped with Ethernet interface as required between the data logger and Heavy Truck Control Data Server.

6.6 Installation

- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.

7. Heavy Truck Control Data Server

7.1 Functions

- Heavy Truck Control Data Server in Toll Office shall be capable to record measured result of each axle weight and number of axles obtained by axle load measurement equipment.
- The heavy truck gross weight shall be calculated based on the measured result of each axle load, and the heavy truck gross weight shall be recorded into the Heavy Truck Control Data Server with above measured results.
- As for the measurement and calculation result for heavy truck gross weight, each axle load, and number of axles of heavy truck shall be recorded as data for one vehicle in the Heavy Truck Control Data Server for all passing vehicles in the axle load measurement system zone.
- The photo of vehicle front obtained by CCTV camera system shall be recorded into the Heavy Truck Control Data Server as the vehicle information for all passing heavy trucks with corresponding heavy truck's measured and calculated results.
- In case some image taken by CCTV camera is not a vehicle, for example operation staff or animal, it shall be properly processed without affecting the linkage of other measured result of axle load and corresponding heavy truck information in the Heavy Truck Control Data Server in toll office.
- In case the measured axle load and/or heavy truck weight exceed the allowable maximum threshold, this fact shall be recorded with the measured result and heavy truck information into the Heavy Truck Control Data Server. The threshold shall be properly configured taking specified weight in Circular 07/2010/TT-BGTVT and measuring equipment component error into consideration.
- In case the measured axle load and/or heavy truck weight exceed the threshold, the measured results, calculation result, and heavy truck information shall be capable to be printed out in one sheet on the appropriate form for such a vehicle.
- The Heavy Truck Control Data Server shall be capable to check on synchronization between axle load measurement equipment and CCTV camera.
- In case, the measured axle load and/or heavy truck weight exceed the maximum threshold, this fact shall be notified by buzzer, flashing light or specific screen display to the operator who monitors the measurement results in the Toll Office and another staff who monitors the measurement result at the end (or further location) of the axle load measurement system zone.
- The recorded data on heavy trucks in Heavy Truck Control Data Server shall be searchable. The search result shall be capable to be displayed on the screen with measured result and calculation result such as heavy truck weight, axle load, number of axles, license plate number, front part photo of corresponding vehicle, and photo of license plate number.

- The heavy truck measured result including calculation result and corresponding heavy truck information stored in the Heavy Truck Control Data Server shall be capable to be printed out in one sheet in an appropriate form.
- The heavy Truck Control Data Server shall be capable to record stored data to other external media as backup.
- The Heavy Truck Control Data Server shall be capable to detect the failure of the equipment components related to axle load measurement, CCTV camera, vehicle detector and alarm. The detected failure shall be identifiable.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices
- The Heavy Truck Control Data Server shall have the structure which is possible to fix in the building in Regional Main Center.
- The structure of Heavy Truck Control Data Server shall be capable to replace the faulty parts simply and easily when it is detected.

7.3 Performance

- The Heavy Truck Control Data Server shall be capable to perform the necessary functions stipulated in item 7.1.
- The Heavy Truck Control Data Server shall be synchronized with all roadside equipment
- The Heavy Truck Control Data Server shall be capable to store the data volume of two (2) years at least for the measured results and calculation result of heavy truck and corresponding heavy truck information.
- The Heavy Truck Control Data Server shall be capable to implement the periodical checking and clean up activities.The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

7.4 Human Machine Interfaces

- The Heavy Truck Control Data Server shall be equipped with necessary human machine interface such as monitor screen, keyboard and mouse.
- Human machine interface, which is able to alert the operator or staff when measured result of axle load and/or heavy truck gross weight exceed the threshold, shall be equipped in toll office. The alarm is to be buzzer, flashing light or specific display on monitor screen.

7.5 Communication Interfaces

- The data transmission between roadside processing function such as data logger and Heavy Truck Control Data Server shall be made over TCP/IP.

7.6 Installation

- Software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely used in many countries.
- The Heavy Truck Control Data Server shall have database system such as Oracle or MySQL or etc.
- The Heavy Truck Control Data Server shall be installed in air conditioned room in Regional Main Center.
- The installation work shall include equipment component's unloading customes clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The equipment component shall be protected with measures against lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

8. Alarm Notification

8.1 Functions

- In case, the measured axle load and/or heavy truck weight exceed the maximum threshold, this fact shall be capable to be notified by buzzer, flashing light or specific screen display to the operator who monitors the measurement results in the Toll Office and another staff who monitors the measurement result at the end (or further location) of the axle load measurement system zone.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with measures against water, rust, dust, salt water in case that equipment components are installed outdoor.
- The chassis of equipment components shall not be opened easily.
- The equipment components shall allow performing maintenance works from the place where the maintenance work minimize the influence to traffic flow.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The equipment component shall be capable to withstand natural conditions, meteorological conditions, electromagnetic noise, and other environmental conditions in Vietnam.

8.3 Performance

- The alarm notification equipment component to be installed each lane of the axle load measurement system zone shall be identifiable aurally and visually for the staff who monitor heavy trucks near the end of the axle load measurement system zone.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

8.4 Human Machine Interfaces

- The alarm notification equipment component to be installed each lane of the axle load measurement system zone shall be capable to alert the operator who monitors heavy trucks near the end of the zone.
- The alarm notification for the operator who monitor the monitor screen of the Heavy

Truck Control Data Server shall be buzzer or appropriate screen display.

8.5 Communication Interfaces

- Communication interfaces shall be properly selected to function well during data and signal transmission between Heavy Truck Control Data Server and Alerm.

8.6 Installation

- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment component shall be protected with measures against lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

9. Mobile Input Terminal

9.1 Functions

- The mobile input terminal shall be connected to any data server by using wireless communication from indoor / outdoor for viewing of the required information and input and update the required information in the data server.
- The equipment shall be transmited the image to any data server, the image is taken by the function of the equipment.

9.2 Structure

- The terminal shall have adequate structure, shape, size, lightweight and robustness.
- The terminal shall be protected against dust and water ingress if it will be installed outdoors in road typical section in accordance with IP66 of the international standards IEC 60529 or equivalent.
- The equipment components shall have robust structure and lightweight for easy to carry.

9.3 Performance

- The terminal shall be capable to connect to the any data server by using wireless communication.
- The terminal shall be capable to connect to any data server for viewing of the required information and input and update the required information in the data server.
- The terminal shall have the function that retrieve the information of GNSS, and shall be capable to trace the location information of the terminal.
- The terminal shall have the function that the ability to connect to the Internet.
- The terminal shall have the function that taking and recording image, send the image to any data server by using wireless communication.
- The terminal shall have the sufficient storage capacity to save the required any data in the terminal.

9.4 Human Machine Interfaces

- The terminal shall have a display device with touch panel function
- The terminal shall be capable to connect to the keyboard input device by wire or wireless interface.
- The terminal shall be capable to taking the still image and moving image by using camera function.

9.5 Communication Interfaces

- The terminal shall have the wireless communication interface such as WiFi (IEEE802.11 b/a/g/n), 3G (IMT-2000) and GSM (900MHz, 1.8GHz) at least.
- The terminal desirable have the wireless communication interface such as Bluetooth for the connection of peripheral device.
- The data transmission between the equipment and the Data Server shall be made over TCP/IP, HTTP.

10. Ambient Conditions

- The equipment component shall be protected against interferences of other electronic devices and electromagnetic noises at the Project site.
- The Heavy Truck Control Data Server, axle load controller or data logger shall be housed in an air conditioned clean room or chassis which can be maintained proper performance of the equipment components.
- Equipment components to be installed outside shall be capable to operate and withstand under the ambient conditions such as natural conditions, meteorological conditions, electromagnetic noise, and other environmental conditions of the Project site in Vietnam. The Contractor shall check ambient conditions of the Project site and proper protection shall be designed for individual equipment components.
- The axle load sensor shall be robust enough to withstand heavy truck passage on it because it is buried in the lane of axle load measurement system.
- The spare parts of the equipment components shall be housed in air conditioned clean room to maintain their proper performance. The accommodation conditions are subject to individual equipment requirements for storage environment.

11. Power Supply

- The main power supply shall be AC220 volts, single phase and 50 Hz frequency.
- The electric power supply for axle load measurement equipment components shall be equipped the redundant power supply for securing continuous operation of the equipment components except for the maintenance period.

12. Maintainability

- The equipment components shall be able to be maintained easily and simply.
- The axle load measurement equipment components and related system shall be able to identify the faulty parts easily in case a fault is detected, and the replacement of the parts shall be simple.
- The spare parts of axle load measurement equipment components and related system shall be available at least five (5) years after the equipment components are handed over to the road management authority, and the supply period of the spare parts shall be guaranteed by the manufacturer.
- The manufacturer of the axle load measurement equipment components and related system shall submit the necessary documents required for the operation and maintenance such as manuals and checklist, and provide necessary training to Operation and Maintenance staff of the related equipment components.
- The manufacturer/supplier of the axle load measurement equipment components and related system shall make a contract for technical support of operation and maintenance related to the delivered equipment components with the road management authority. The manufacturer/supplier shall provide the necessary services based on the contract.

13. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit the copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.
- The axle load measurement equipment component functions shall be verified before delivery, and the contractor/manufacturer shall deliver with certificate of verification.

14. Testing/Inspection

1) General

The Test and Inspection for the axle load measurement equipment components shall be implemented in accordance with the following conditions;

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are two types of tests: factory test and connection test of axle load measurement system and overloading management system. The connection test includes both axle load measurement and overloading management equipment components and related systems such as alarm, vehicle detector, CCTV camera, etc.

(3) As for the inspection, the connection inspection is basically to be witnessed.

(4) Tests and Inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) Test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation

(1) The manufacturer's factory test procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) Both test and inspection procedures shall be submitted to the road management authority and the consultant.

(4) After approval of the connection test procedure, the contractor will perform its own connection test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(5) After approval of inspection procedure, the inspection for the system connection shall be implemented witnessed by the road management authority and the consultant.

3) Necessary Document

All procedures of the tests and the inspection shall be submitted to the road management

authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project.

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(21)
Measurement Lane Monitoring

1. General Outline

This functional package allows the road operators to monitor current conditions of vehicle passage and operations by workers by using cameras installed in a separated lane for axle load measurement of the expressway.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, and in tollbooths and toll offices of the expressway network for activating functional packages.

3. Relevant Regulations and Standards

- ISO 14813-1:2007: Intelligent transport systems – Reference model architecture(s) for the ITS sentor – Part 1: ITS service domains, service groups and services
- IEC 60529: Degrees of Protection provided by Enclosure (IP Code)
- ISO/IEC 14496-2: (MPEG4-Part 2)
- IEEE 802.3: (Ethernet)
- ISO/IEC 14496: (Coding of audio-visual objects)

4. Requirements

1) International Standards

- System shall be capable of monitoring vehicles passing through a tollgate lane, in the toll booth and toll office, and identifying their type such as truck, bus and sedan.
- System shall be capable of monitoring toll payment/receipt transaction between a driver and a toll collector in the toll office.
- System shall be capable of storing the needed video images.
- System shall be capable of showing and printing out the needed results.
- System shall be capable of installing roadside equipment adequately in the limited space around a tollgate lane.
- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

2) National Standards

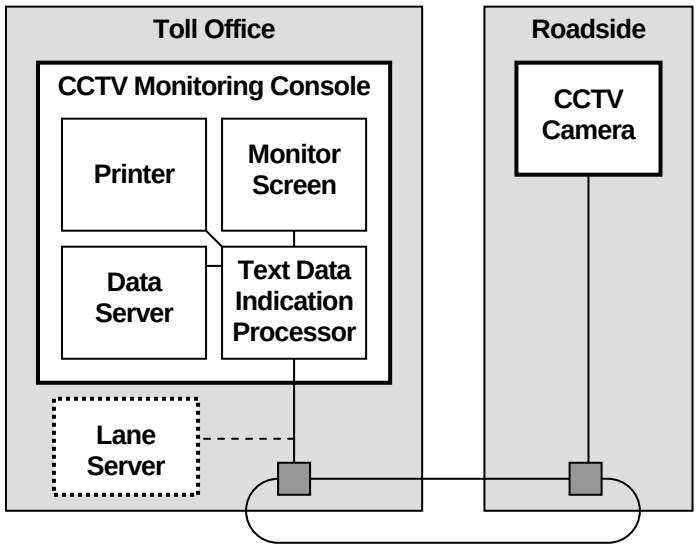
- Circular 07/2010/TT-BGTVT: Legal regulation for measurement of overloaded heavy truck

- Decree No. 34/2010/ND-CP: Processing for measured overload heavy truck
- TCVN 4054
- TCVN 5729

5. System Architecture

System architecture for lane monitoring for axle load measurement is shown below.

Figure 5.1 System Architecture for Measurement Lane Monitoring



: Location : Equipment Package : Detailed Device
: Software

Broken Lines: Outside of This Functional Package

6. CCTV Camera

6.1 Functions

- To monitor vehicles in the toll lane and identify types of the vehicles by their appearance.
- To supervise money transferring transactions between toll collector and driver.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The equipment components shall be capable of synchronizing its clock to the clock of "CCTV Monitoring Console" at start-up.
- CCTV system shall be capable of correcting brightness of captured image automatically. (That is called as the iris function.)
- CCTV system shall have auto-focus function to be controlled from "CCTV Monitor Console".
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

6.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.
- The equipment components shall be protected with the measures against water, rust, dust, salt water in case equipment components are installed outdoors.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The equipment components shall allow maintenance works from the sides and/or back, but not from lane direction, in order to minimize the influence to traffic activities.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with the measures against interference from other electronic devices.
- Fixed CCTV camera shall be protected against dust and water ingress if it will be installed outdoors in road typical section in accordance with IP66 of the international standards IEC 60529 or equivalent.
- The system shall be capable of fully meeting the requirements even under night conditions.
- The Fixed camera shall be capable of complying with CS–mount standards.

6.3 Performance

- The system shall be capable of controlling the lens aperture in tune with the brightness of the subject and of outputting the best suited video image.
- The system shall have video image output interface to adjust angle of view of camera and receiving control signal interface to check camera operations at setup at installation site.
- The equipment components shall be capable of taking images road traffic by at least Black/White image for continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The equipment component shall be supplied with Device Driver for controlling camera functions. ONVIF compliance is required for CCTV cameras.
- Size of image sensor must be greater than 1/4".
- Minimum focal length of lens must be between 3.0mm and 5.0mm, and may be changed based on CS mount lens.
- The camera resolution must be greater than 1 mega pixel or 1280x720.
- The minimum illumination in day mode and night mode should be lower than 1.0 lx and 0.1 lx respectively, without slow shutter function.
- The camera must be capable of encoding in H.264, MPEG4-Part2 and Motion JPEG.
- The camera shall be protected in accordance with IP66, ISO/IEC 60529.
- The frame rate should be greater than 25 fps.
- The camera must consumed power less than 50W.
- The camera can operate at -30 to 50 degrees with humidity range from 20 to 90% (non-condensing).
- The maximum surveillance range should be greater than 30m without zooming functions.
- The device’s weight should be less than 4.0 kg.

6.4 Human Machine Interfaces

- CCTV camera shall have the function to output test image to personal computers at site so that installation staff may adjust the direction of the camera.
- The system shall have video image output interface to adjust angle of view of camera and receiving control signal interface to check camera operation at setup at installation site.

6.5 Communication Interface

- The system shall be capable of providing control signal to transmit the images over TCP/IP.

- The equipment components shall be capable of having following communication interfaces in order to ensure that equipment components to be controllable with CCTV, and accessible to CCTV video images from another equipment / console.
  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Transmission data format
  - Timing chart and other details of the standard interfaces
- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.
- The system shall have video image output interface to adjust angle of view of camera and receiving control signal interface to check setup of camera operations at installation site.

6.6 Installation

- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- The equipment components shall be installed at the toll island where they are capable of taking images of the front image of vehicles (including Licence Plate) .
- Horizontal and vertical angle of CCTV camera shall be adjustable and shall be fixed appropriately.
- CCTV camera shall be capable of being vertically and horizontally adjusted during installation at roadside.
- The equipment components shall have adequate robustness against the wind of speed according to TCVN 2737:1995.
- CCTV cameras shall be installed so that direction of camera may not be rotated by strong wind.
- CCTV camera shall be installed so that images may not swing by strong wind.In case the equipments to be located at outdoor, the screw for attachment should be antitheft type.
- In case the equipments to be located at outdoor, the screw for attachment should be antitheft type.
- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.

- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment and materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.

7. CCTV Monitoring Console

7.1 Functions

- To monitor vehicles in axle load measurement zone of the toll lane and identify the vehicles by their appearance.
- The equipment components shall be capable of synchronizing its clocks to the clock of “Heavy Truck Control Data Server” at start-up.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with measures against lightning.
- The chassis of equipment components shall not be opened easily, and its door shall have a lock.
- The chassis of equipment shall be capable of dissipating temperature rising from inside equipment.
- The equipment components shall be protected with measures against interference from other electronic devices.

7.3 Performance

- The equipment components shall display the images captured by CCTV camera.
- The system shall control the zoom, pan/tilt functions of all cameras.
- The system shall display the camera image selected by the operating staff on the monitor.
- The sizeof monitor screen shall be 20 inches or over.
- The system shall allow operating staff to monitor all displayed images.
- The monitors shall be controlled as follows
  - The number of operators not enough for monitoring all CCTV images displayed on Monitor Screens.
  - Multiple images shall be separately displayed on the same Monitor Screen.
  - Images of different cameras shall be displayed on the same Monitor Screen with defined rotating intervals.
- The system shall be capable to capture CCTV images as still pictures.
- The system shall be capable to print the captured image using A4 type printer.
- The system shall accumulate captured CCTV images in a database in Heavy Truck Control Data Server. Additionally, the system shall be capable to store accumulated images for 30 days at least.
- The system shall be capable to display accumulated CCTV images on the monitor screen.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

7.4 Human Machine Interface

- The equipment components shall have human-machine interface for the Traffic Information Operator to input necessary commands into the system.
- The display unit shall have the input and output terminals, such as D-sub, HDMI, RS-232C and LAN port.

7.5 Communication Interface

- The system shall transmit all data and signals over TCP/IP.
- The equipment components shall have the following communication interfaces in order to ensure that equipment components are CCTV controllable, and CCTV video images are accessible from another equipment / consoles.
  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices

- Transmission data format
- Timing chart and other details of the standard interfaces

- Necessary information or specification of equipment components shall be capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

7.6 Installation

- The software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The equipment components shall be installed in the Toll Office.
- The installation work shall include equipment component's unloading customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- The equipment components shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.

8. Ambient Conditions

- The equipment components shall be installed in the offices, toll booth, outside and shall be protected with the measures against interferences of other electronic devices.
- The equipment component shall be capable of normally operating under the following ambient conditions.

For Main Center, Toll Management Center, and Toll Office
Temperature: 25 +/- 3 degree C in average
Relative humidity: between 20 and 80 % in average
For outside
Temperature: between - 0 and +50 degree C
Relative humidity: below 95 % in average

9. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.
- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for at least 30 minutes.

10. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The system shall be capable of identifying the faulty parts easily in case equipment fault is detected, and replacement of the parts shall be simple.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the equipment components shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the staff to be work as O&M staff of the related equipment components.
- The manufacturer of the equipment components shall make a contract for technical support of operation and maintenance related to the delivered equipment components with the road management authority. The manufacturer shall provide the necessary services based on the contract.

11. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit a copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

12. Testing/Inspection

1) General

The Test and Inspection for the equipment components shall be implemented in accordance with the following conditions:

(1) The test means test of contractor, manufacturer or and/or the company in charge of installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test with roadside equipment components and servers.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be borne by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory test procedure and its inspection procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of authorized staff of road management authority and/or the consultant

(4) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(5) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(6) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(7) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the road management authority and the consultant.

(8) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the road management authority and the consultant.

(9) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant.

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including the following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(22)
Communication System

1. General Outline

This functional package allows the road operators to exchange data for ITS among the regional main center, the road management offices and pieces of roadside equipment by using the backbone network among the center, which comprises fibre optic cables installed in the shoulder along the expressways and communication nodes, and access network between communication nodes and roadside terminals.

2. Scope

Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, and in the Regional Main Center, road management offices, toll management offices/center and tollbooths of the expressway network for actualizing functional packages.

3. Relevant Regulations and Standards

- ITU-T G.803: Architecture of transport networks based on the synchronous digital hierarchy (SDH)
- ITU-T G.703: Physucal/electrical characteristics of hierchical digital interface
- ITU-T G.652: Characteristics of single-mode optical fibre cable
- ITU-T G.655: Characteristics of a non-zero dispersion shifted single-mode optical fibre cable
- ITU-T G.114:One-way transmission time
- IEEE 802.3: Ethernet (Carrier Sense Multiple Access with Collision Detection)
- ITU-T Y.1541: Network performance objectives for IP-based services
- BS 7430: Earthing
- BS 6651:Lightning Protection

4. Requirements

- System shall be capable of exchanging data including video images among roadside equipment on the expressways, the Main Center and road management offices.
- System shall be capable of transmitting interactive voice communications between Main Center, road management offices and toll management offices.
- System shall be capable of transmitting directives to the units concerned simultaneously and with top-priority at any time for clearing incidents and enforcing traffic regulations.
- IP version 6 shall be deployed for the National Layer Network, which connects between

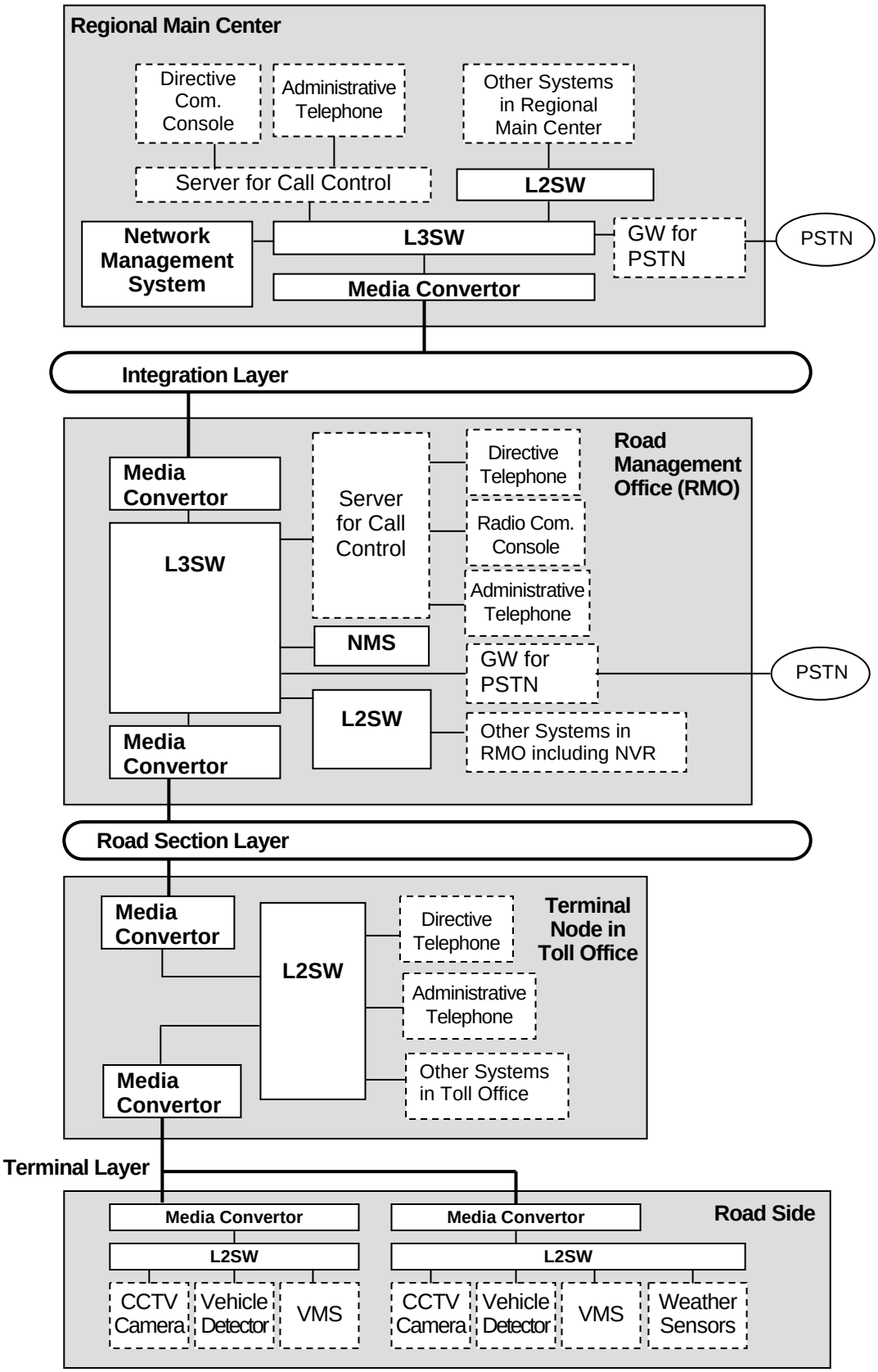
Regional Main Centers, and Integration Layer Network.

- System shall be capable of identifying location of problems that occur on communication network and of recovering from them by automatic switching network.
- System shall be capable of functioning 24 hours a day, 365 days a year using a redundant system with sufficient durability/reliability of equipment components.
- In case, part or whole of procurement and operation & maintenance of the Center/Roadside Communication is to be outsourced to other organization such as telecommunications carrier or operator, it should be outsourced based on the mutually agreed document such as contract which makes clear system demarcation points and each party's responsibility.

5. System Architecture

System architecture for communication system is shown below.

Figure 5.1 System Architecture for Communication System



6 Switching Equipment Component

6.1 Functions

- The switching equipment component shall be capable to switch all ITS related communication traffic.
- The switching equipment component shall be secured to connect all directive communications whenever it is required without calling loss.
- The switching equipment component shall comply with international standards.
- The switching equipment component for Integration Layer Network and National Layer Network shall be capable to deploy IP version 6.
- The switching equipment components shall have compatibility of interfaces for connection with the transmission equipment components.
- There are several types of directives from the Regional Main Center: directive to all, directive to concerned Road Management Office and directive to the specific offices including Toll Office. The switching equipment components shall recognize these different types of directives based on directions from the operator through the directive communication console.
- The switching equipment component shall be capable of controlling Quality of Service for all ITS communication traffic basically. In addition, for delay sensitive traffic such as voice communication shall be controlled within the specified performance.
- The fault of the switching equipment component shall be capable to be detected and capable to be notified to the operating staff. During emergency repair time after detection of the system fault, continuous operation shall be secured with minimal interruption with the redundant equipment component.
- The switching equipment component shall have been accepted by road operators, communication carriers or operators in the countries other than the originally manufactured country.

6.2 Structure

- The switching equipment component shall have sufficient durability for operating 24 hours a day, 365 days a year.
- The switching equipment components shall have a design which is possible to fix in the building, housing or cabinet.
- Faulty parts of the switching equipment components shall be replaceable simply and easily when fault is detected.
- The switching equipment component shall be capable of implementing periodic

checking and clean up activities.

6.3 Performance

- The performance of the switching equipment component shall be guaranteed to switch and connect the required communication traffic in appropriate timing within the requirements stipulated in the concerned sections of the specifications.

- The voice communication for directive communications and administrative telephone shall be complied with the conditions of Class 0 of ITU-T Recommendation Y.1541 within the communication network of ITS.

- The directive communication from Regional Main Center shall be connected without any connection loss. As for the Administrative Telephone, the connection loss shall be within 10%.

- The speech quality of the voice communications shall comply with or be equivalent to the quality of fixed line telecommunications carrier, and have at least the following performance:

  Directive Communication:

  From Directive Console to the terminal equipment component to receive the directive call: within 18dB

  Administrative Telephone:

  From end terminal equipment component to another end terminal equipment component: within 26dB

- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year. During maintenance and repair period, the operation shall be continued with redundant components.

6.4 Human Machine Interface

- The switching equipment components shall have human-machine interface so that the operation and maintenance staff can make diagnosis of the switching equipment component, input necessary commands, and execute necessary operation and maintenance activities.

- The switching equipment components shall detect the fault of the equipment components. When a fault is detected, the system shall be capable to issue notification alert such as buzzer or flashing light on the display to the O&M staff.

- The switching equipment components shall have human-machine interface so that the operator can input necessary commands into the system.

- The traffic data server shall be capable of management by remote control.

6.5 Communication Interfaces

- The communication interfaces of the switching equipment components shall comply with international standards.
- The communication interfaces of the switching equipment component shall not be hindrance of transmission of moving image, data, signal and voice.

6.6 Installation

- The Installation work shall include equipment component's unloading, customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Switching Equipment Components shall be installed in an air conditioned room, in Regional Main Center, Road Management Offices, Toll Offices and other necessary places.
- If the switching equipment component is required to install outside of the building as Terminal Node, it shall be selected suitable equipment or chassis to resist environmental conditions to be specified below.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- Necessary materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the switching equipment components bonding with the grounding of the lightning protection system and other grounding facilities installed within a short distance.
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

7. Transmission Equipment Component

7.1 Functions

- The transmission equipment component shall be capable to transmit all ITS related communication traffic.
- The transmission equipment component shall be secured to transmit the directive communications during the emergency cases.
- The transmission equipment component shall be complied with the international standard.
- The transmission equipment component shall be capable of controlling Quality of Service for all ITS communication traffic basically. In addition, for delay sensitive traffic such as voice communication shall be controlled within the specified performance.
- Any fault of the transmission equipment components shall be detected by the network management system that shall be able to notify it to the operation staff. During emergency repair time after detection of the network fault, redundant equipment component shall be used to operate the network without interruption.
- Transmitting data through the communication network shall be capable of maintaining appropriate security conditions.
- The transmission equipment component functions shall be confirmed by road operators, communication carriers or operators in foreign countries excluding the original manufacturing country.

7.2 Structure

- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year.
- The transmission equipment components shall be able to be fixed in the building or chassis.
- The transmission equipment components shall allow replacement of the faulty parts simply and easily when a fault is detected.
- The transmission equipment components shall allow implementing periodic checking and clean up activities.

7.3 Performance

- The transmission equipment components shall transmit the required communication traffic in appropriate timing under the conditions stipulated in the concerned sections of this specifications.
- The voice communication for directive communications and administrative telephone shall be complied with the conditions of Class 0 of ITU-T Recommendation Y.1541 within the communication network of ITS.

- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year. During maintenance and repair period, the operation shall be continued with redundant components.

7.4 Human Machine Interfaces

- The transmission equipment components shall have human machine interface so that the operation and maintenance staff can make diagnosis of the transmission equipment component, input necessary commands, and execute other necessary operation and maintenance activities.
- When the fault of the transmission equipment components is detected by network management system, an alarm function such as buzzer or alert screen on the display will notify it to the O&M staff.
- The switching equipment components shall have human-machine interface so that the operator can input necessary commands into the system.
- The traffic data server shall be capable of management by remote control.

7.5 Communication Interfaces

- The communication interfaces of the switching equipment components shall comply with international standards.
- The communication interfaces of the switching equipment component shall not be hindrance of transmission of moving image, data, signal and voice.

7.6 Installation

- The Installation work shall include equipment component's unloading, customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Transmission Equipment Component shall be installed in an air conditioned room in Regional Main Center, Road Management Offices, Toll Offices and other necessary places.
- If the Transmission Equipment Component is required to install outside of the building as Terminal Node, it shall be selected suitable equipment or chassis to resist environmental conditions to be specified below.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.

- Necessary materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment components shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

8. Optical Fiber Cable

8.1 Functions

- Optical Fiber Cable is applied for ITS communication network basically whose distance exceeds transmittable distance of cupper cable.
- The single mode optical fiber cable shall be applied for ITS communication network, and it shall be complied with ITU-T G652.D.
- Any fault of the Optical Fiber Cable shall be able to be detected by the network management system and shall be notified to the operating staff. During emergency repair time after detection of the network fault, redundancy shall allow operation of the network without interruption.
- Transmitting data through the communication network shall be capable of maintaining appropriate security conditions.
- The functions of Optical Fiber Cable to be used shall have been confirmed by road operators, communication carriers or operators in foreign countries excluding the original manufacturing country.

8.2 Structure

- The optical fiber cable is basically to be installed in ducts.
- The optical fiber cable shall have sufficient capability to resist against rodent attack.

8.3 Performance

- The optical fiber cable to be used shall be capable to transmit required communication traffic under the required conditions stipulated in the concerned sections of the specifications.
- The performance of optical fiber cable shall be complied with the conditions specified in ITU-T G.652.D.
- The measuring instruments identifying optical fiber cable fault location, and other instruments necessary for operation and maintenance of the optical fiber cable shall be provided by the manufacturer of the optical fiber cable and training how to use those instruments shall be provided to the O&M staff. However if this part is being outsourced to other organization, such necessary conditions shall be specified in the outsourcing contract documents.
- The necessary tools to replace and maintain the optical fiber cables and jointing tools and materials for the cables shall be provided for the road management organization by the cable manufacturer. Necessary training shall be provided to the O&M staff of the road management organization by the manufacturer of the optical fiber cable. However if this part is being outsourced to other organization, such necessary

conditions shall be specified in the outsourcing contract documents.

8.4 Human Machine Interfaces

- When a fault of the optical fiber cable is detected by network management system, the function to notify, such as by buzzer or alert screen on the display, to the O&M operator shall be equipped.
- The measuring instruments to be used for normal maintenance or fault detection of the optical fiber cables such as Optical Time Domain Reflectometer (OTDR), with the proper size display to show the measurement result, shall be equipped.

8.5 Communication Interfaces

- The interface of optical fiber cable shall comply with international standards, and shall not be a hindrance to transmission of moving image, data, signal and voice.

8.6 Installation

- The Installation work shall include equipment component's unloading, customs clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.
- The Optical Fiber Cable shall be installed in between media converters to be located in Regional Main Center, Road Management Offices, Terminal Nodes, Toll Offices and to be located close to the roadside equipment components, where the physical network connection is required.
- The Contractor shall prepare the detailed cable installation drawings due consideration of the existing facilities.
- The cable termination frame and other necessary materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- If necessary, the equipment components shall be protected from the lightning strike and electrical surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within a short distance.
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

9 Network Management System

9.1 General Outline

The Network Management System to be located in a Road Management Office shall be capable to monitor Road Section and Terminal Layer Network under the Road Management Office. The NMS to be located in a Regional Main Center shall be capable to monitor Integration Layer Network under the Regional Main Center.

All network equipment components shall be capable to be monitored by at least one of the above Network Management Systems.

9.2 Functions

NMS shall be required to equip the following functions;

(1) Monitoring Alert and Notification Function

Function for detection of origination and recovery of various types of alert and monitoring L3SW, L2SW, transmission equipment/route, roadside equipment is required. Recording function of alert log is necessary, and displaying/printing out function is also required whenever required. Notification function to the operating staff by buzzer or flashing light is also required.

(2) Resource Management Function

Function of monitoring operation condition of L3SW, L2SW, transmission equipment/route, roadside equipment which is connected to the network is required. When system configuration is modified, the function of adding system, registration and modification of the equipment component should be also equipped. During replacement of the equipment component, it should be distinguished “Operating Condition” and “under installation”.

(3) Performance Monitoring Function

The function to monitor the communication traffic on the network is required.

(4) Testing Function

Testing function of Communication line and connecting conditions of communication equipment should be equipped.

(5) Switching Function to the Redundant Equipment Component

The switching function to the redundant equipment component should be equipped automatically basically when failure is detected, and it should be capable to distinguish operation conditions of equipment components such as “Normal” or “Trouble” for both in operation and redundant equipment components. If it is not switched over to the redundant equipment component, NMS should be equipped to switch it over manually on mandatory basis.

9.3 Structure

- The NMS shall have sufficient durability for 24hours a day, 365 days a year.
- The NMS shall have the structure which is possible to fix in the building, housing or cabinet.
- The structure of NMS shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of NMS shall be capable to implement the periodical checking and clean up activities.
- Chassis of equipment shall be capable of dissipating temperature rising from inside equipment.

9.4 Performance

- The performance of NMS shall be guaranteed so as to indicate fault and failure on its display immediately enough for NMS operator to comprehend the fault or failure of communication network before the operator of Traffic Information/Control found the fault or failure of the roadside equipment component, if the fault or failure belongs to communication network.
- The monitoring target of NMS shall be switches, transmission equipment components, communication cables, and necessary monitoring items shall be selected in order to detect fault location and faulty conditions clearly.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year.

9.5 Human Machine Interface

- The NMS shall have human-machine interface so that operation and maintenance staff can monitor it and make diagnosis of the system, input the necessary command, and execute necessary operation and maintenance activities.
- When the fault is detected, the NMS shall be capable to notify it as alert such as buzzer or flashing light on display to the O&M staff.

9.6 Communication Interface

- The communication interfaces of NMS shall be complied with the international standard

9.7 Installation

- The Installation work shall include equipment component’s unloading, customs

clearance, inland/domestic transportation, equipment component installation, software installation, set up, configuration, testing/inspection and commissioning. Initial instruction, hand-over of the equipment and submission of all required documents such as drawings, data and manuals prepared through execution of the Project shall be considered as the part of the installation work.

- Information of detection of alert by NMS shall be shared in the traffic control room in the Regional Main Center so that traffic control operator on duty can recognize it.
- The Contractor shall prepare the detailed equipment layout drawings due consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- Software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely used in many countries.
- The necessary materials shall be painted and finished in accordance with the relevant codes and standards. Paint quality and method of application shall conform to appropriate standards and be able to withstand ambient conditions to be specified below.
- The equipment component shall be protected from the lightning strike and lightning surge. The earth resistance shall be maximum 10 ohm, and common earthing protection shall be applied to the equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.
- The security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

10. Ambient Conditions

- The equipment component shall be protected against interferences of other electronic devices and electromagnetic noises at the Project site.
- The switches, transmission equipment components and NMS shall be housed in an air conditioned clean room or chassis which can be maintained proper performance of the equipment components.
- Equipment components to be installed outside shall be capable to operate and withstand under the ambient conditions such as natural conditions, meteorological conditions, electromagnetic noise, and other environmental conditions of the Project site in Vietnam. The Contractor shall check ambient conditions of the Project site and proper protection shall be designed for individual equipment components.
- The spare parts of the switches, transmission equipment components and NMS shall be housed in air conditioned clean room to maintain their proper performance. The accommodation conditions are subject to individual equipment requirements for storage environment.

11. Power Supply

- The main power supply shall be AC220 volts, single phase and 50 Hz frequency.
- The electric power supply for Center/Roadside Communication system shall be equipped with redundant power supply for securing the operation of the equipment components for 24 hours a day 365 days a year.

12. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The switches, transmission equipment components and NMS shall be able to identify faulty parts easily in case a fault is detected, and the replacement of the parts shall be simple.
- The spare parts of switches, transmission equipment components, optical fiber cables and NMS shall be available at least five (5) years after the equipment components are handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of switches,transmission equipment components, optical fiber cable and NMS shall submit the documents necessary for the operation and maintenance such as manuals and checklist, and necessary training shall be provided to the related O&M staff.
- The manufacturer of switches, transmission equipment components, optical fiber cable and NMS shall make a contract for technical support of operation and maintenance related to the delivered equipment components with the road management authority, and the manufacturer shall provide necessary services based on the contract.

13. Quality Control

- The manufacturer of the equipment components shall provide ISO9001 authentication of manufacturing division of equipment components to be delivered under the project and final inspection division before shipping.
- The manufacturer shall be required to submit a copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

14. Testing/Inspection

1) General

The Test and Inspection for switches, transmission equipment components, optical fiber cable and NMS shall be implemented in accordance with the following conditions;

(1) The test means test of contractor, manufacturer or and/or the company in charge of

installation work, and Inspection means the part of the test demonstrated by the contractor and witnessed by the authorized staff of the road management authority and/or the consultant. If it is completed successfully, it will be accepted.

(2) There are three types of tests: factory test, unit test of the equipment component at site after installation, and connection test of completed communication system.

(3) There are also three types of inspections similar to the tests. The connection inspection is recommended to be witnessed.

(4) All inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be born by the contractor, manufacturer, and/or the company in charge of installation work.

(5) The test and inspection shall include at least the inventory check, visual inspection, and performance test.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory test procedure shall be submitted to the road management authority and the consultant for approval

(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.

(3) The equipment component unit test procedure at site after its installation shall be submitted to the road management authority and the consultant for approval.

(4) After approval of the unit test procedure, the unit test shall be executed and the test result shall be submitted to the road management authority and the consultant.

(5) If necessary, the road management authority and/or the consultant may request to implement the inspection of the equipment component unit test at site.

(6) The test and inspection procedure of the connection test for communication system including switches, transmission equipment component, optical fiber cable and NMS shall be submitted to the road management authority and the consultant.

(7) After approval of the connection test procedure, the contractor's own connection test shall be implemented and the test result shall be submitted to the road management authority and the consultant.

(8) The inspection for the system connection shall be implemented and witnessed by the road management authority and the consultant.

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management authority and the consultant for approval in appropriate timing before commencement of the tests and inspections, respectively in hard copy including following:

(1) The test and inspection procedure shall include test and inspection items, descriptions and drawings related to the items, check list which includes items and brief descriptions of items, and acceptable conditions, threshold, and/or criteria of each item, and blank space for the test or inspection result.

(2) In the checklist, blank space for the authorized person's signature, date, and venue shall be also included.

4) Other Conditions

At least the following conditions shall be determined in each project:

(1) The submission deadline of each test and inspection procedure

(2) The submission deadline of the contractor's own test result

(3) The issuing deadline of related certificate from the road management authority and the consultant

(4) The necessary number of submission documents

(23)
Communication Ducts

1. Duct and Chamber Works in earthwork sections

1.1 Design Concept

(1) General

The Contractor shall carry out the detailed site survey, and shall prepare the construction drawings and submit to MOT and the consultant for approval before commencement of the work. The Construction plan shall be prepared based on “National technical regulation on cable duct, cable jointing chamber and cross connection cabinet” by the contractor.

The kind of construction drawings are as follows:

1. Communication Duct Layout
2. Section Drawings
3. Details of Chamber

(2) Duct and Chamber

Underground duct route shall be selected under shoulder or median in principle, but not to select carriage-ways as far as possible. In the underground duct to be newly constructed, and shall be composed of High Density Poly-ethylene (HDPE) pipes in principal. Ducts shall be handed and installed through the chamber.

Types of Chamber listed below shall be applied.

* Type M1: This chamber handles cables and for keeping them slack. Regular interval is approximately 333 m.

* Type M2: This chamber connects the ducts from earthwork section to the bridge. It is set behind abutment.

* Type M3: This chamber is for installing and connecting cables. Regular interval is approximately 2.0 km.

* Type M4: This chamber is set at changing point of cable direction both horizontally and vertically.

Chamber type shall be selected appropriately. The contractor shall make arrangement plan for chambers and submit to MOT and the consultant

(3) Cable Rack and Cable Brackets

Cable Rack and Cable Brackets in the Chamber shall be described in the Tenderer’s Technical Proposal.

1.2 Installation and Construction Standards

(1) General

1 Duct and Chamber works shall be performed in accordance with the specification stipulated hereinafter.

2 Other installation and/or construction works, the detail of which is not specified in this section, shall be based on the Contractor's own Technical Specifications, subject to the MOT's approval.

3 MOT shall obtain permission for the excavation and site occupancy form proper authorities if required and shall inform the Contractor in writing. The contractor shall provide MOT the necessary drawing and/or data if required.

4 The Contractor shall provide adequate safety guards and warning signs, such as indicating boards, lights, barricades and other proper warning signs as required during excavation, chamber construction and all other constructions and/or installation activities.

5 Accessibility to fire hydrants and private driveways shall always be secured by adequate arrangement.

6 If it is necessary, MOT shall notify the other utilities and local authorities concerned upon request of the Contractor when construction shall be commenced, and shall start his work after MOT's approval.

7 MOT and/or the consultant shall, at any time when deemed necessary during the construction period, carry out inspections and/or tests on the facility under construction and/or the portions of facilities completed by Contractor.

Should any discrepancy in construction, fault materials and/or other evidence of unsatisfactory constructions and installations be discovered in the course of such inspection and/or tests, the Contractor shall immediately repair, replace and remedy such unsatisfactory items.

8 The contractor shall demonstrate the proof that the quality and quantity of the hidden portion have been compiled with the specification, at his own expense.

9 The contractor shall apply the Area Log Book in order to facilitate a full supervision on the construction work.

The Area Log Book shall be used for recording various important items and be kept as an official record.

(2) Chamber

1 Chamber shall be equipped with covers and frames, duct plug, ladders, steps, cable racks, cable brackets, name plates and pulling irons.

2 The contractor shall comply with the following specifications for mixing, pouring and curing of the concrete:

a. All chambers shall be constructed with a ready-mixed or site-mixed concrete.

b. The concrete, when made with a normal Portland Cement, shall attain a minimum compressive strength of fc'=18N/mm2.

c. Slump range for the concrete used in the construction of chamber shall be between 5 and 12cm.

MOT may require the slump test for every batch of the concrete.

d. MOT may order three (3) test pieces from any batch of the concrete to be taken and property marked for the laboratory test, as required.

3 The concrete shall be slowly poured around the molds or forms up to adequate level evenly and tamped into all parts of the molds or forms by using a vibrator until a densely solid mass without cavities is obtained.

4 The concrete, once mixed, shall be used within 60 minutes (one hour). After one hour, any remaining concrete shall be removed and shall not be used.

5 Bottom of the pit shall be tamped and carefully leveled and shall be covered with approximately 10 cm of the foundation aggregate.

6 Cement mortar shall consist of one (1) measure of Portland cement and two (2) measures of sand. Materials shall be thoroughly mixed in a dry state on a non-absorbent base and then worked up with sufficient water to form a stiff paste. Mortar, once mixed, shall be promptly used. If not used within one hour, the mixture shall be removed and shall not be used.

7 The concrete shall be covered with saturated sack-cloth or similar materials and shall be sprinkled with water to keep the sufficient moisture, adequate times a day for 7 days.

8 Removal of inner and outer forms shall not be permitted within 7 days and 4 days respectively after pouring the concrete.

9 No traffic shall be permitted over chambers earlier than 7 days after the concrete pouring.

(3) Excavation for Duct and Chamber

1 All excavation shall be done in a thorough and workmanlike manner in accordance with detailed plans and specifications under the direction of MOT /the consultant and subject to the approval and acceptance of MOT.

2 MOT shall obtain permission for the excavation and site occupancy from proper authorities if required and shall inform the Contractor in writing. The contractor shall provide MOT the necessary drawing and/or data if it is required. Permission shall include property owners' approvals for necessary work on their properties.

3 The contractor shall obtain all pertinent records from the Electric, Water Supply, and Sewer Authority and other organizations for underground utilities in order to proceed his work and safe-guard to other utilities if required.

4 The contractor shall take all countermeasures necessary for public safety and protection to any and all temporary or permanent utilities.

5 The contractor shall be directly responsible for all damages to existing utilities including telecommunication facilities accompanied by his excavation or installation. The contractor shall restore these existing utilities immediately at his own expense.

6 During the execution of the work, if existing underground facilities are damaged, or any part thereof is disturbed, the Contractor shall immediately notify of the facts to MOT and owner of the utility.

7 Where other underground facilities are expected, the Contractor shall dig test pits at the location in question at his own expense. If any obstructions which interfere with the excavation of the Chamber or the Duct trench in conformance with detailed drawings are encountered, the Contractor shall consult with MOT on modification of the design.

8 The Contractor shall strictly take the countermeasure for safety at all times to prevent the accident by the sudden cave-in during the excavation.

9 The Contractor shall confirm with the MOT and other relevant authority to ensure about the proposed depth of Chamber to the final grades and level of carriage-ways and footways.

10 The Contractor shall excavate the trench based on the Contractor's own Technical Standard or Installation Standard or requirement of concerned authority. Any excess in width of trench shall be at the Contractor's own expense including extra restoration of pavement.

11 The Contractor shall, at his own expense, protect and support any pipe, conduit, cable, wire or any other items of telephone or foreign plant exposed or encountered during the excavations. The Contractor shall be obliged to restore all items to their original conditions and to the satisfaction of MOT and the owners of such plants.

12 The trench shall be so arranged as to avoid any longitudinal concave profile of conduit. Trench shall be arranged with smoothly and gradual descending grade so as to terminate ducts at the specified location of the Chamber as per the Detailed Drawings.

13 The Contractor shall consult with MOT and/or the Consultant about the clearance between Ducts and other utilities.

(4) Installation of Ducts

1 Installation of Ducts shall be carried out in accordance with the specification provided hereinafter.

2 Other installation details not specified herein shall be governed by the Contractor's own specifications approved by MOT.

3 Trenching, backfilling and restoration shall be carried out in accordance with the approved construction drawings and the Contractor's own specifications.

4 The Contractor shall proceed the duct placing work upon MOT's confirmation of both the duct quality and trench to be properly prepared according to the specification.

5 Ducts shall be installed in a straight line, horizontally and vertically, wherever practicable.

6 The covering depth from the top of HDPE ducts to the surface of ground shall be as follows:

a. Median……. 50 cm or more

b. Shoulder…….. 70 cm or more

However, in special case, the depth shall be determined in consultation with MOT or the Consultant.

7 The clearance between the conduit formation and trench wall shall be kept wide enough to permit adequate compaction of backfilling.

8 Main duct runs must be completed from the chamber without interruptions or breaks and must be installed with perfect alignment of the duct way.

9 The warning tape shall be laid throughout the duct trench, approximately 35 cm under the top surface in median and 55 cm under the top surface in shoulder.

(5) Laying Practice for Rigid HDPE

1 Bedding

Excavation of trenches shall be made in accordance with the approved construction drawing and the contractor's own Technical Specifications approved by MOT. The bottom of trench shall be flattened after removing stones and other protrusion.

The bedding of 5 cm thickness shall be made by fine sand or equivalent, free from pebbles and other foreign materials, and shall be well tamped.

2 Laying Work

a Pipes laying on the trench bed shall be straightened. Then the spacer shall be placed on ducts appropriately along the duct run.

b Fine sand or equivalent shall be placed and tamped with adequate water.

c Backfilling with sand or equivalent shall be carried out in layers as mentioned above, until the top of uppermost pipes is covered with at least 15 cm of tamped such sand.

d All opening ends of HDPE pipes shall be tightly plugged in order to prevent ingress of sands and other obstacles during the work.

e Application of short Pieces of the HDPE Pipe

Any pieces of the HDPE pipe shorter than 0.5 meter shall not be used in laying of duct run.

If any piece of the HDPE pipe is used, the inside edge of the cut end of the pipe shall be chamfered about 3 mm, before jointing the pipe to another HDPE pipe.

f All HDPE pipes shall be chamfered on inside edges.

g Installation of Curved Pipe

The pipe shall be bent in such manners to protect the pipe from the flattening distortion.

(6) Duct Termination to Chamber

1 The ducts generally shall be installed to the Chamber wall, facing the wall at right angles; the allowable deviation of angle shall be less than 20 degrees.

2 The duct termination shall be flush with the inside surface of the chamber wall. The edge shall be chamfered and smoothed.

(7) Jointing Practice for Rigid HDPE Pipes

1 Jointing of the HDPE pipe shall be carried out one by one successively, as a rule, in the duct trench.

2 Each section of duct shall be securely connected to each adjoining section of the duct in a manner that prevents the ingress of dirt or the penetration of water.

3 When more than one layer of ducts is installed, each layer shall be installed so as to stagger joints of each layer.

(8) Arrangement of HDPE Ducts in Chamber

1 The end of HDPE ducts shall be terminated in Chamber. The opening of ducts shall be located on the specified position of the wall of Chamber.

2 HDPE ducts shall be fixed tightly to the wall of Chamber. For this purpose, incoming ducts shall be reinforced by concrete.

(9) Mandrel Test

Upon completion of conduit sections, loose materials such as concrete, mud, dirt, sand, etc. shall be cleaned out from new ducts before testing. Mandrel test shall be carried out appropriately under the approval of MOT.

(10) Guide rope Installation to All Ducts

After completion of the conduit installation, guide rope shall be installed for all ducts. The guide rope end shall be bind to the pulling iron inside of the Chamber.

(11) Duct Plug installation to All Ducts

After installation of guide rope to all ducts, duct ends shall be closed firmly with duct plugs.

(12) Backfilling

1 Prior to the backfilling work, the inspection or various underground works shall be made and, if any faulty items are discovered, necessary measure to replace or restore the fault shall be taken immediately.

2 Backfilling shall be commenced after notification to MOT and/or the Consultant.

3 When carrying out the backfilling work, following procedures shall be proceeded:

a Before backfilling, all foreign objects shall be removed from the excavation.

b In asphalted or concrete median and shoulder, the specification of each authority concerned shall be applied to construct the base course.

(13) Restoration of Road, Side-Walk and Median

1 The contractor shall be obliged to restore all surface and base courses at his own expenses, to original conditions in accordance with the respective specification of authorities concerned. The work shall not be completed unless authorities concerned and other owner agree to accept the restoration.

2 The restoration for excavated roads shall be done in accordance with the following:

a Unpaved Road

For restoring of unpaved roads, the Contractor shall carry out the restoration to its original condition. The permanent restoration of the excavated road shall be checked and certified by authorities concerned.

b Paved Road

All of the restoration work shall be carried out by the Contractor in accordance with the direction of authorities concerned. All the restoration cost shall be borne by the Contractor.

1.3 Inspection and Acceptance Test

(1) General

1 Site inspection specified herein shall be performed throughout installations and constructions of the various types of Communication Duct facilities.

2 Should any errors in construction, faulty materials or other evidence of unsatisfactory construction and installation are found in the course of tests, the Contractor shall immediately repair, replace and/or remedy such unsatisfactory items.

3 The Contractor shall perform the facility inspection by himself every time to see and check if the work meet the requirement before the acceptance test.

4 Acceptance test specified shall be performed by the Contractor under the supervision of MOT and/or the Consultant.

5 Necessary equipments and materials for the site inspection and the acceptance test shall be provided by the Contractor at his own expense. Written reports including the test results shall be prepared by the Contractor and verified by MOT.

The Contractor shall submit one (1) original and two (2) copies of the test data to MOT.

(2) Chamber

1 The following test shall be carried out in the presence of MOT and/or the Consultant:

a Slump of concrete mixture

b Compressive strength of concrete

c Materials for Chamber

2 Dimension and structure of Chamber shall be within the following tolerance:

a Inside dimension Chamber

Length -5 cm

Width -3 cm

Height -3 cm

b Wall thickness ……..-0 cm

c Covering of reinforcing bar ..+/- 1 cm

3. Wall of the Chamber shall be free from cracks and water infiltration, and inner walls of the chamber shall be smoothed.

4. Duct edges shall be chamfered and smoothed.

5. Level of the Chamber cover shall be flush with the road surface level.

(3) Duct

1 Mandrel passage test shall be carried out for all ducts.

2 Compaction and material tests for backfilling according to the specification of the authorities may be carried out.

3 No foreign materials shall remain in all ducts.

4 Covering depth of ducts shall conform to the approved construction drawings or Contractor's own technical standard.

(4) Restoration

Result and process of restoration shall conform to the specification of MOT or concerned authorities.

2. Material Specification for Duct and Chamber in earthwork sections

2.1 HDPE Pipe

(1) Requirements

1 The pipe shall have smooth outside and inside surface and shall be free from injurious flaws, streaks, cracks, twists and other defects.

2 The pipe shall be practically straight in form.

3 Both ends of pipe shall be cut exactly perpendicular to the pipe axis and shall be free from chips and rough edges.

(2) Dimensions

Detailed dimensions of the structure are as shown in the following Table.

Dimension of PVC Pipe

No	Pipe Size	Inner diameter (mm)	Outer diameter (mm)	Wall thickness (mm)	Normal length (m)	Diameter of a pipe roll (m)
1	OSPEN ξ 30	30 ± 2,0	40 ± 2,0	1,2	200	1,2 x 0,55
2	OSPEN ξ 40	40 ± 2,0	50 ± 2,0	1,2	200	1,5 x 0,6
3	OSPEN ξ 50	50 ± 2,5	65 ± 2,5	1,5	100	1,6 x 0,65
4	OSPEN ξ 65	65 ± 2,5	85 ± 2,5	1,8	100	1,7 x 0,7
5	OSPEN ξ 80	80 ± 3,0	105 ± 3,0	2,1	100	1,8 x 0,7
6	OSPEN ξ 100	100 ± 3,0	130 ± 3,0	2,2	100	2,0 x 0,75
7	OSPEN ξ 125	125 ± 3,5	160 ± 3,5	2,4	50	1,7 x 1,1
8	OSPEN ξ 150	150 ± 4,0	190 ± 4,0	2,8	50	1,8 x 1,2
9	OSPEN ξ 175	175 ± 4,0	230 ± 4,0	3,0	50	2,1 x 1,2
10	OSPEN ξ 200	200 ± 4,0	260 ± 4,0	3,5	50	2,3 x 1,3
OSPEN 150	150 ± 4.0	190 ± 4.0	2,8 ± 0,5	45 ± 1.5	50	0,85 x 1,75
OSPEN 175	175 ± 4.0	230 ± 4.0	3,5 ± 0,6	55 ± 1.5	40	0,85 x 2,10
OSPEN 200	200 ± 4.0	260 ± 4.0	4,0 ± 0,8	60 ± 1.5	30	0,90 x 2,15

(3) Properties

The properties of all rigid HDPE pipes shall be in accordance with the following Table.

Properties of Rigid HDPE

PROPERTIES	TESTING MEHOTDS	INDEX	UNITS
Pipe pressing force	DIN 16-96	72,5 : 1300	daN
Breaking strength	ISO 1798	1666,6 : 5729	N/cm^2
Compressive	TM D 604	4,14 : 16,1	daN/cm^2
Breakdown voltage	TCVN 5935-95	26:50:00	kV
Dnesity	TM D 1505	0.958	g/cm^3
Colour Dutability	DATM D 747	123	^oC
Heat expansion	AM D 638	$1,3 \times 10^4$	Deg
Flexural strength		2,8	daN/mm^2
Bending ratio		10	%
Shear strength	ASTM D 2240	3,2	daN/mm^2
Handness	ASTM D 690	66	D-Scale
Tensile strength	ASTM D 570	150	daN/mm^2
Oil resistant strength	ASTM D 22117	>95	%
Ageeing themal	ASTM D 1525	>94/5	%
VICAT sortening point		95 : 98	^oC
Working temperature		-60 : 60	^oC

(4) Storage

Pipes shall not be exposed in direct sunlight and shall be stored in such a manner that sagging or bending shall be prevented.

2.2 Cement

All cement used in underground construction shall be Portland Cement and in accordance with TCVN 12 or equivalent. The cement shall be stockpiled in such a manner as to afford easy access for inspection. Cement shall be kept dry at all times prior to use in order to prevent deterioration. Open air storage of cement shall not be permitted.

Any deteriorated cement shall not be used.

All cement used in the Work shall conform to the following minimum requirements:

Criteria		Test Method
1. Compressive strength, N/mm^2 (MPa), shall exceed: - After 3 days ± 45 minutes - After 28 days ± 8 hours	 21 40	TCVN6016:1995
2. Setting time, minute: - Beginning time, not earlier than - Ending time, not later than	 45 375	TCVN6017:1995
3. Fineness: - Retaining on sieve 0.08mm, %, not exceed - Surface defined by Blaine method, cm^2/g, not less than	 15 2700	TCVN4030:1985
4. Stability of volume (mm), defined by Le Chatelier method, not exceed	10	TCVN6017:1995
5. SO_3 content (%), not exceed	3.5	TCVN141:1998
6. MgO content (%), not exceed	5.0	TCVN141:1998
7. The amount to be lost when burning (MKN) (%), shall not exceed	5.0	TCVN141:1998
8. The amount of sediment without dissolving (CKT) (%), not exceed	1.5	TCVN141:1998

2.3 Water

All water used for mixing and curing of concrete shall be supplied by the waterworks. Water from other sources may be used only if authorized by MOT after tests have shown the quality to be equal to or better than that supplied by the waterworks. Water from any source which has been contaminated with dirt, oil, salt or other foreign substances shall not be used.

2.4 Fine Aggregate

(1) The fine aggregate for concrete shall consist of natural river sand or equivalent material.

(2) The fine aggregate shall be uniformly graded and shall meet the grading requirements as shown in the following Table.

Fine Aggregate

Sieve Designation	Percentage by Weight Passing square mesh sieve
(10.0 mm)	100
No. 4 (5.0 mm)	95 to 100
No. 16 (1.2 mm)	45 to 80
No. 50 (0.3 mm)	10 to 30
No. 100 (0.15 mm)	2 to 10

(3) The fine aggregate shall be stored in such a manner as to prevent mixture with other aggregate prior to the use and also to prevent inclusion of foreign materials.

2.5 Coarse Aggregate

(1) The coarse aggregate for concrete shall consist of crushed stones having hard, strong and durable pieces free from adherent coatings such as mud or other foreign materials. The coarse aggregate shall be graded between maximum sizes of 25 mm and minimum size corresponding to No. 4 (5 mm) sieve size. It must be free from dirt, floury stone dust, earth or any similar materials.

(2) The coarse aggregate shall be stored in such a manner as to prevent mixture with other aggregate prior to the use and also to prevent inclusion of foreign materials.

(3) Aggregate for Resurfacing

Aggregate for resurfacing shall be composed of crushed rock consisting of fragments of clean durable stone, free from thin and soft pieces, disintegrated rock, dirt or other foreign materials and shall satisfy the requirements of the authorities concerned.

2.6 Reinforcing Bar

Reinforcing bars shall be deformed steel bars. The bars shall be free from dirt, oil, paint, grease, thick rust and other defects, and shall conform to the following requirements:

1 Tensile stress at Minimum 440 N/mm2

2 Yield Point at Minimum 300 N/mm2

2.7 Spacer for Ducts

The spacer shall be fabricated of plastic or similar materials in order to keep the proper space and duct formation for installed ducts. The dimensions and forms of the spacer shall be described in the Technical Proposal.

3. Duct and Chamber Works in bridge sections

3.1 Design Concept

(1) General

The Contractor shall carry out the detailed site survey, and shall prepare the construction drawings and submit to MOT and the consultant for approval before commencement of the work. The Construction plan shall be prepared based on “National technical regulation on cable duct, cable jointing chamber and cross connection cabinet” by the contractor.

The kind of construction drawings are as follows:

1. Communication Duct Layout
2. Section Drawings
3. Details of Camber

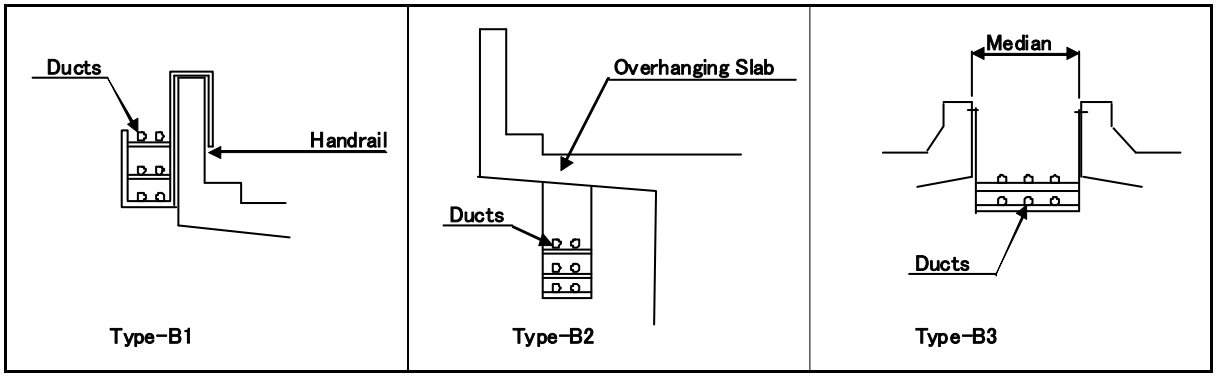
(2) Duct and Chamber

On bridges the ducts should be set on the outer side of the bridge not in median for easy construction and maintenance. However, in case of Ha Noi Ring Road 3, the ducts must be set in the median due to structural difficulty for setting on the outer side and with regard for aesthetics.
Duct shall be composed of HDPE pipes in principal.
There are three types of supporting methods for ducts on bridges as shown in Figure 3.1.

Basically Type-B should be adopted because of easy construction and maintenance as well as large track record. Type-A is adopted in case of an old bridge in order to protect the old concrete without using much anchoring.

Type-C is a special case, only adopted in Ha Noi Ring Road 3 because of the structural difficulty for setting on bridge outer side and with regard for aesthetics.

Figure3.1 Type of supporting method for ducts on bridges



Source: ITS Standards & Operation Plan Study Team

Ducts shall be handed and installed through the chamber.

Types of Chamber listed below shall be applied. Chambers on bridges shall be made of steel.

* M5 : This chamber is set at bridge section in which communication ducts are hung from cantilever slabs. It is for maintaining cables slack against expansion and contraction of bridge. Regular interval is approximately 100 m.
  For bridges which its length is over 2.0km or M5 chamber which needs to connect to roadside equipment, a closure shall be installed in the chamber.
* M6 : This chamber is set at bridge section in which communication ducts are hung from handrail at medians. It is for maintaining cables slack against expansion and contraction of bridge. Regular interval is approximately 100 m.
  For bridges which its length is over 2.0km or M6 chamber which needs to connect to roadside equipment, a closure shall be installed in the chamber.

Chamber type shall be selected appropriately. The contractor shall make arrangement plan for chambers and submit to MOT and the consultant

(3) Cable Rack and Cable Brackets

Cable Rack and Cable Brackets in the Chamber shall be described in the Tenderer's Technical Proposal.

3.2 Installation and Construction Standards

(1) General

1 Duct and Chamber works shall be performed in accordance with the specification stipulated hereinafter.

2 Other installation and/or construction works, the detail of which is not specified in this section, shall be based on the Contractor's own Technical Specifications, subject to the MOT's approval.

3 MOT shall obtain permission for the field erection and site occupancy form proper authorities if required and shall inform the Contractor in writing. The contractor shall provide MOT the necessary drawing and/or data if required.

4 The Contractor shall provide adequate safety guards and warning signs, such as indicating boards, lights, barricades and other proper warning signs as required during erection and all other constructions and/or installation activities.

5 Accessibility to fire hydrants and private driveways shall always be secured by adequate arrangement.

6 If it is necessary, MOT shall notify the other utilities and local authorities concerned upon request of the Contractor when construction shall be commenced, and shall start his work after MOT's approval.

7 MOT and/or the consultant shall, at any time when deemed necessary during the construction period, carry out inspections and/or tests on the facility under construction and/or the portions of facilities completed by Contractor.

Should any discrepancy in construction, fault materials and/or other evidence of unsatisfactory constructions and installations be discovered in the course of such inspection and/or tests, the Contractor shall immediately repair, replace and remedy such unsatisfactory items.

8 The contractor shall demonstrate the proof that the quality and quantity of the hidden portion have been compiled with the specification, at his own expense.

9 The contractor shall apply the Area Log Book in order to facilitate a full supervision on the construction work.

The Area Log Book shall be used for recording various important items and be kept as an official record.

(2) Supporting structure for ducts and Chamber made of steel

1 Supporting structure shall be composed by shaped steel, steel bar and other steel equipment.

2 Chamber shall be equipped with covers and frames, duct plug, ladders, steps, cable racks, cable brackets, name plates and pulling irons.

3 The contractor shall comply with the following specifications for fabrication and erection of steel structure.

(3) Fabrication of structural steel

1 Before any technical submittals are made, the contractor shall submit his proposed schedule for all shop drawing submissions, materials submissions, and fabrication processes. The contractor shall not proceed with any purchase or fabrication of materials until the relevant shop drawings have been approved by MOT and the consultant. The contractor shall not proceed with any welding until MOT and the consultant have approved his Welding Plan.

2 Before any work is done on it, all plates shall be checked for flatness and all bars sections checked for straightness and freedom from twist.

3 Cutting shall be done automatically. Hand cutting may be used exceptionally. Oxygen cutting may be used provided a smooth and regular surface free from cracks. All cut plate edges that will not be welded shall be ground flush and all edges of plates and sections that will not be welded shall be rounded to the appropriate radius for painting or galvanizing.

4 Holes for bolts shall be drilled.

5 Bending of plate may be machined by cold processes, provided that the bending inner radius is at least 15 times the thickness of the plate.

6 All welding shall be planned and executed using the most suitable materials and working method for the particular purpose. Site welding will only be permitted for fixtures and details of any fixture welding proposed by the contractor must be clearly identified on the shop drawings and referred to in the accompany submittal letter.

7 All steel members shall be galvanized in accordance with JIS H8641 or equivalent.

(4) Transport, Handling and Storage of structural steel

1 The method of transporting and handling shall be subject to the approval of MOT and the consultant. Special care shall be taken in the packing, method of supporting, lifting during handling and transporting of structural steel work which is shop assembled before delivery, to ensure protection from damage.

2 Immediately following delivery to the site, the contractor shall check the materials and bring immediately to the notice of the consultant or his representative any damage or defects therein.

3 Materials to be stored shall be placed on skids above the ground and shall be kept clean and properly drained.

(5) Field Erection of structural steel

1 Prior to the start of fabrication the contractor shall submit for a full description of his proposed erection method for the approval of MOT and the consultant.

2 The material shall be carefully handled so that no parts will be bent, broken or otherwise damaged.

3 The Contractor shall strictly take the countermeasure for safety at all times to prevent the accident

(6) Installation of Ducts

1 Installation of Ducts shall be carried out in accordance with the specification provided hereinafter.

2 Other installation details not specified herein shall be governed by the Contractor’s own specifications approved by MOT.

3 Field Erection shall be carried out in accordance with the approved construction drawings and the Contractor’s own specifications.

4 The Contractor shall proceed the duct placing work upon MOT‘s confirmation of both the duct quality and supporting structure to be properly prepared according to the specification.

5 Ducts shall be installed in a straight line, horizontally and vertically, wherever practicable.

(7) Duct Termination to Chamber

1 The ducts generally shall be installed to the Chamber wall, facing the wall at right angles; the allowable deviation of angle shall be less than 20 degrees.

2 The duct termination shall be flush with the inside surface of the chamber wall. The edge shall be chamfered and smoothed.

(8) Arrangement of HDPE Ducts in Chamber

1 The end of HDPE ducts shall be terminated in Chamber. The opening of ducts shall be located on the specified position of the wall of Chamber.

2 HDPE ducts shall be fixed tightly to the wall of Chamber. For this purpose, incoming ducts shall be reinforced by concrete.

(9) Jointing Practice for Rigid HDPE Pipes

1 Jointing of the HDPE pipe shall be carried out one by one successively, as a rule, on the supporting structure.

2 Each section of duct shall be securely connected to each adjoining section of the duct.

3 When more than one layer of ducts is installed, each layer shall be installed so as to stagger joints of each layer.

(10) Arrangement of HDPE Ducts in Chamber

1 The end of HDPE ducts shall be terminated in Chamber. The opening of ducts shall be located on the specified position of the wall of Chamber.

2 HDPE ducts shall be fixed tightly to the wall of Chamber. For this purpose, incoming ducts shall be reinforced by concrete.

(11) Mandrel Test

Upon completion of conduit sections, loose materials such as concrete, mud, dirt, sand, etc. shall be cleaned out from new ducts before testing. Mandrel test shall be carried out appropriately under the approval of MOT.

(12) Guide rope Installation to All Ducts

After completion of the conduit installation, guide rope shall be installed for all ducts. The guide rope end shall be bind to the pulling iron inside of the Chamber.

(13) Duct Plug installation to All Ducts

After installation of guide rope to all ducts, duct ends shall be closed firmly with duct plugs.

3.3 Inspection and Acceptance Test

(1) General

1 Site inspection specified herein shall be performed throughout installations and constructions of the various types of Communication Duct facilities.

2 Should any errors in construction, faulty materials or other evidence of unsatisfactory construction and installation are found in the course of tests, the Contractor shall immediately repair, replace and/or remedy such unsatisfactory items.

3 The Contractor shall perform the facility inspection by himself every time to see and check if the work meet the requirement before the acceptance test.

4 Acceptance test specified shall be performed by the Contractor under the supervision of MOT and/or the Consultant.

5 Necessary equipments and materials for the site inspection and the acceptance test shall be provided by the Contractor at his own expense. Written reports including the test results shall be prepared by the Contractor and verified by MOT.

The Contractor shall submit one (1) original and two (2) copies of the test data to MOT.

(2) Steel structure

1 The following test shall be carried out in the presence of MOT and/or the Consultant

* Materials

* Welding

(3) Chamber

1 The following test shall be carried out in the presence of MOT and/or the Consultant:

Materials for Chamber

2 Dimension and structure of Chamber shall be within the following tolerance:

a Inside dimension Chamber

Length	-1 cm
Width	-1 cm
Height	-1 cm

b Wall thickness ……..-0.05 cm

(4) Duct

1 Mandrel passage test shall be carried out for all ducts.

2 No foreign materials shall remain in all ducts.

(5) Restoration

Result and process of restoration shall conform to the specification of MOT or concerned authorities.

4. Material Specification for Duct and Chamber in bridge sections

4.1 HDPE Pipe

Same as section 2.1.

4.2 Structure steel

Structure steel shall be free from dirt, oil, paint, grease, thick rust and other defects, and shall conform to the following requirements:

1 Tensile stress at Minimum 440 N/mm2

2 Yield Point at Minimum 300 N/mm2

Structure steel shall be newly rolled and shall conform to the requirements of the following specifications or their ASTM equivalents.

* JIS G3101, JISG3106, JIS G 3114

4.3 Reinforcing Bar

Reinforcing bars shall be deformed steel bars. The bars shall be free from dirt, oil, paint, grease, thick rust and other defects, and shall conform to the following requirements:

1 Tensile stress at Minimum 440 N/mm2

2 Yield Point at Minimum 300 N/mm2

4.4 Spacer for Ducts

The spacer shall be fabricated of plastic or similar materials in order to keep the proper space and duct formation for installed ducts. The dimensions and forms of the spacer shall be described in the Technical Proposal.

(24)
Base Structures

1. Base Structure Works

1.1 Design Concept

(1) General

The Contractor shall carry out the detailed site survey, and shall prepare the construction drawings and submit to MOT and the consultant for approval before commencement of the work. The Construction plan shall be prepared by the contractor.

The kind of construction drawings are as follows:

1. Details of Base Structure

(2) Poles for small equipment

1 Pole for CCTV

A single steel pole should be adopted in order to install each CCTV unit as shown in Figure 24.1 left.

2 Pole for CSS

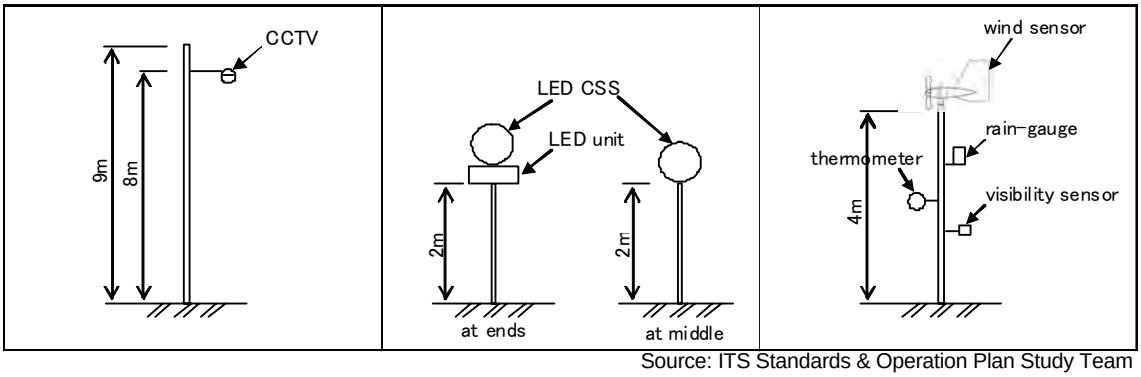
In order to install Changeable Speed Limit Sign, two types of poles should be adopted as shown in Figure 24.1 centre. One is for installing at the ends of a expressway, one is at middle of a expressway.

3 Pole for Weather observation equipment

In order to install 4 equipment units as listed below, a pole of D=200 mm, h=4.0 m should be adopted as shown in Figure 24.1 right.

* Rain-Gauge
* Wind Sensor
* Visibility Sensor
* Thermometer

Figure 24.1 Poles for small equipment



Source: ITS Standards & Operation Plan Study Team

(3) Gantry for VMS

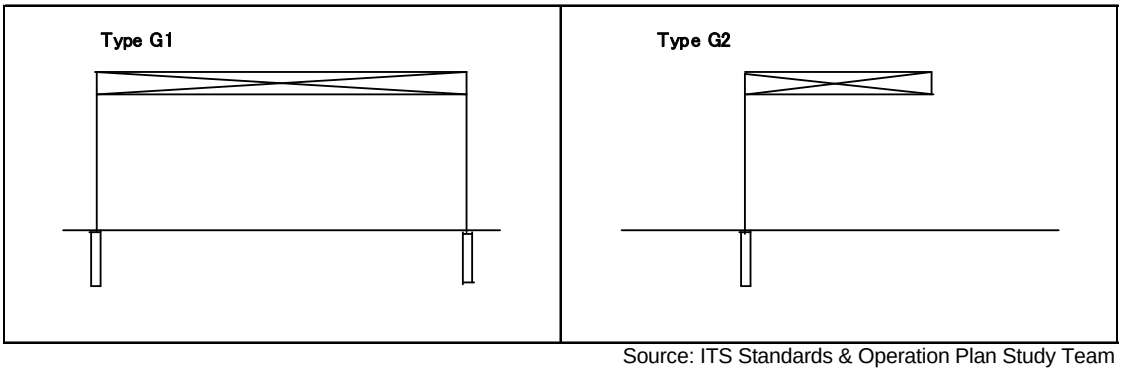
VMS is designed to set at an earthwork section and a bridge section. Because gantries for VMS are not included in dead loads when existing bridges have been designed, gantries for VMS set at a bridge section should be installed at ground level.

Two groups of gantries for VMS mentioned as above, are shown in Figures 24.2 and 24.3 respectively.

Gantry for VMS set at Earthwork section	G1 : Standard frame type
	G2 : Cantilever type
Gantry for VMS set at Bridge section	G3 : Special type on bridge on Ha Noi Ring Road 3

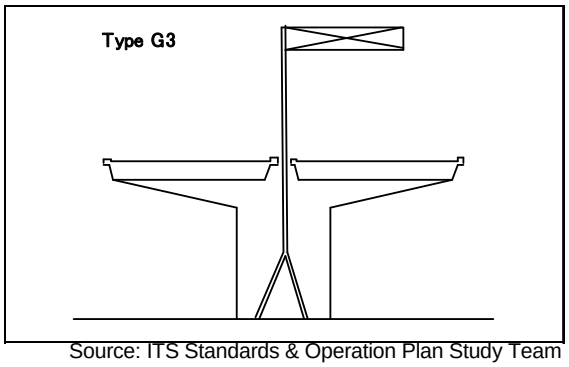
The pole of G3 must be widen near the ground to reduce the deflection that is caused by cantilever-beam and it's height.

Figure 24.2 Gantry for VMS in earthwork area



Source: ITS Standards & Operation Plan Study Team

Figure 24.3 Gantry for VMS on bridge

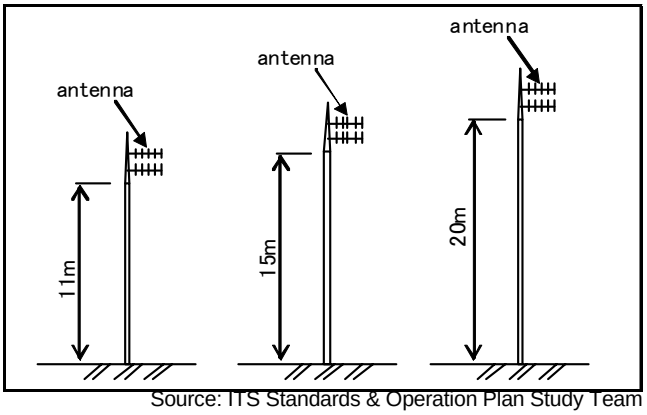


Source: ITS Standards & Operation Plan Study Team

(4) Tower for Mobile Radio communication

In order to install an antenna that will cover about 8 km area for Mobile Radio communication, a steel pipe tower should be adopted as shown in Figure 24.4
The height of tower should be 11.0 m,15.0m, 20.0m. Tower height shall be designed depending on a radio disturbance surrounding antennas.

Figure 24.4 Tower for Mobile Radio communication



Source: ITS Standards & Operation Plan Study Team

1.2 Construction Standards

(1) General

1 Base Structure works shall be performed in accordance with the specification stipulated hereinafter.

2 Other installation and/or construction works, the detail of which is not specified in this section, shall be based on the Contractor's own Technical Specifications, subject to the MOT's approval.

3 MOT shall obtain permission for the field erection and site occupancy form proper authorities if required and shall inform the Contractor in writing. The contractor shall provide MOT the necessary drawing and/or data if required.

4 The Contractor shall provide adequate safety guards and warning signs, such as indicating boards, lights, barricades and other proper warning signs as required during erection and all other constructions and/or installation activities.

5 Accessibility to fire hydrants and private driveways shall always be secured by adequate arrangement.

6 If it is necessary, MOT shall notify the other utilities and local authorities concerned upon request of the Contractor when construction shall be commenced, and shall start his work after MOT's approval.

7 MOT and/or the consultant shall, at any time when deemed necessary during the construction period, carry out inspections and/or tests on the facility under construction and/or the portions of facilities completed by Contractor.

Should any discrepancy in construction, fault materials and/or other evidence of unsatisfactory constructions and installations be discovered in the course of such inspection and/or tests, the Contractor shall immediately repair, replace and remedy such unsatisfactory items.

8 The contractor shall demonstrate the proof that the quality and quantity of the hidden portion have been compiled with the specification, at his own expense.

9 The contractor shall apply the Area Log Book in order to facilitate a full supervision on the construction work.

The Area Log Book shall be used for recording various important items and be kept as an official record.

(2) Excavation for foundation

1 All excavation shall be done in a thorough and workmanlike manner in accordance with detailed plans and specifications under the direction of MOT /the consultant and subject to the approval and acceptance of MOT.

2 MOT shall obtain permission for the excavation and site occupancy from proper authorities if required and shall inform the Contractor in writing. The contractor shall provide MOT the necessary drawing and/or data if it is required. Permission shall include property owners' approvals for necessary work on their properties.

3 The contractor shall obtain all pertinent records from the Electric, Water Supply, and Sewer Authority and other organizations for underground utilities in order to proceed his work and safe-guard to other utilities if required.

4 The contractor shall take all countermeasures necessary for public safety and protection to any and all temporary or permanent utilities.

5 The contractor shall be directly responsible for all damages to existing utilities including telecommunication facilities accompanied by his excavation. The contractor shall restore these existing utilities immediately at his own expense.

6 During the execution of the work, if existing underground facilities are damaged, or any part thereof is disturbed, the Contractor shall immediately notify of the facts to MOT and owner of the utility.

7 Where other underground facilities are expected, the Contractor shall dig test pits at the location in question at his own expense. If any obstructions which interfere with the excavation for foundation in conformance with detailed drawings are encountered, the Contractor shall consult with MOT on modification of the design.

8 The Contractor shall strictly take the countermeasure for safety at all times to prevent the accident by the sudden cave-in during the excavation.

9 The Contractor shall confirm with the MOT and other relevant authority to ensure about the proposed depth of foundation to the final grades and level of carriage-ways and footways.

10 The Contractor shall excavate the trench based on the Contractor's own Technical Standard or Installation Standard or requirement of concerned authority. Any excess in width of trench shall be at the Contractor's own expense including extra restoration of pavement.

11 The Contractor shall, at his own expense, protect and support any pipe, conduit, cable, wire or any other items of telephone or foreign plant exposed or encountered during the excavations. The Contractor shall be obliged to restore all items to their original conditions and to the satisfaction of MOT and the owners of such plants.

(3) Construction of foundation

1 The contractor shall comply with the following specifications for mixing, pouring and curing of the concrete:

a. All foundations shall be constructed with a ready-mixed or site-mixed concrete.

b. The concrete, when made with a normal Portland Cement, shall attain a minimum compressive strength of fc'=18N/mm2.

c. Slump range for the concrete used in the construction of chamber shall be between 5 and 12cm.

MOT may require the slump test for every batch of the concrete.

d. MOT may order three (3) test pieces from any batch of the concrete to be taken and property marked for the laboratory test, as required.

2 The concrete shall be slowly poured around the molds or forms up to adequate level evenly and tamped into all parts of the molds or forms by using a vibrator until a densely solid mass without cavities is obtained.

3 The concrete, once mixed, shall be used within 60 minutes (one hour). After one hour, any remaining concrete shall be removed and shall not be used.

4 Cement mortar shall consist of one (1) measure of Portland cement and two (2) measures of sand. Materials shall be thoroughly mixed in a dry state on a non-absorbent base and then worked up with sufficient water to form a stiff paste. Mortar, once mixed, shall be promptly used. If not used within one hour, the mixture shall be removed and shall not be used.

5 The concrete shall be covered with saturated sack-cloth or similar materials and shall be sprinkled with water to keep the sufficient moisture, adequate times a day for 7 days.

6 Removal of outer forms shall not be permitted within 4 days respectively after pouring the concrete.

7 No traffic shall be permitted over foundations earlier than 7 days after the concrete pouring.

(4) Fabrication of structural steel

1 Before any technical submittals are made, the contractor shall submit his proposed schedule for all shop drawing submissions, materials submissions, and fabrication

processes. The contractor shall not proceed with any purchase or fabrication of materials until the relevant shop drawings have been approved by MOT and the consultant. The contractor shall not proceed with any welding until MOT and the consultant have approved his Welding Plan.

2 Before any work is done on it, all plates shall be checked for flatness and all bars sections checked for straightness and freedom from twist.

3 Cutting shall be done automatically. Hand cutting may be used exceptionally. Oxygen cutting may be used provided a smooth and regular surface free from cracks. All cut plate edges that will not be welded shall be ground flush and all edges of plates and sections that will not be welded shall be rounded to the appropriate radius for painting or galvanizing.

4 Holes for bolts shall be drilled.

5 Bending of plate may be machined by cold processes, provided that the bending inner radius is at least 15 times the thickness of the plate.

6 All welding shall be planned and executed using the most suitable materials and working method for the particular purpose. Site welding will only be permitted for fixtures and details of any fixture welding proposed by the contractor must be clearly identified on the shop drawings and referred to in the accompany submittal letter.

7 All steel members shall be galvanized in accordance with JIS H8641 or equivalent.

(5) Transport, Handling and Storage of structural steel

1 The method of transporting and handling shall be subject to the approval of MOT and the consultant. Special care shall be taken in the packing, method of supporting, lifting during handling and transporting of structural steel work which is shop assembled before delivery, to ensure protection from damage.

2 Immediately following delivery to the site, the contractor shall check the materials and bring immediately to the notice of the consultant or his representative any damage or defects therein.

3 Materials to be stored shall be placed on skids above the ground and shall be kept clean and properly drained.

(6) Field Erection of structural steel

1 Prior to the start of fabrication the contractor shall submit for a full description of his proposed erection method for the approval of MOT and the consultant.

2 The material shall be carefully handled so that no parts will be bent, broken or otherwise damaged.

3 The Contractor shall strictly take the countermeasure for safety at all times to prevent the accident

1.3 Inspection and Acceptance Test

(1) General

1 Site inspection specified herein shall be performed throughout installations and constructions of the various types of Base structure for Communication facilities.

2 Should any errors in construction, faulty materials or other evidence of unsatisfactory construction and installation are found in the course of tests, the Contractor shall immediately repair, replace and/or remedy such unsatisfactory items.

3 The Contractor shall perform the facility inspection by himself every time to see and check if the work meet the requirement before the acceptance test.

4 Acceptance test specified shall be performed by the Contractor under the supervision of MOT and/or the Consultant.

5 Necessary equipments and materials for the site inspection and the acceptance test shall be provided by the Contractor at his own expense. Written reports including the test results shall be prepared by the Contractor and verified by MOT.

The Contractor shall submit one (1) original and two (2) copies of the test data to MOT.

(2) Steel structure

1 The following test shall be carried out in the presence of MOT and/or the Consultant

* Materials

* Welding

(3) Foundation

1 The following test shall be carried out in the presence of MOT and/or the Consultant:

a Slump of concrete mixture

b Compressive strength of concrete

2 Dimension of foundation shall be within the following tolerance:

a Foundation size ……..-0 cm

b Covering of reinforcing bar ..+/- 1 cm

(4) Restoration

Result and process of restoration shall conform to the specification of MOT or concerned authorities.

2. Material Specification for Base Structure

2.1 Structural steel

Structure steel shall be free from dirt, oil, paint, grease, thick rust and other defects, and shall conform to the following requirements:

1 Tensile stress at Minimum 440 N/mm2

2 Yield Point at Minimum 300 N/mm2

Structure steel shall be newly rolled and shall conform to the requirements of the following specifications or their ASTM equivalents.

* JIS G3101, JISG3106, JIS G 3114

2.2 Cement

All cement used in underground construction shall be Portland Cement and in accordance with TCVN 12 or equivalent. The cement shall be stockpiled in such a manner as to afford easy access for inspection. Cement shall be kept dry at all times prior to use in order to prevent deterioration. Open air storage of cement shall not be permitted.

Any deteriorated cement shall not be used.

All cement used in the Work shall conform to the following minimum requirements:

Criteria		Test Method
1. Compressive strength, N/mm^2 (MPa), shall exceed: - After 3 days ± 45 minutes - After 28 days ± 8 hours	 21 40	TCVN6016:1995
2. Setting time, minute: - Beginning time, not earlier than - Ending time, not later than	 45 375	TCVN6017:1995
3. Fineness: - Retaining on sieve 0.08mm, %, not exceed - Surface defined by Blaine method, cm^2/g, not less than	 15 2700	TCVN4030:1985
4. Stability of volume (mm), defined by Le Chatelier method, not exceed	10	TCVN6017:1995
5. SO_3 content (%), not exceed	3.5	TCVN141:1998
6. MgO content (%), not exceed	5.0	TCVN141:1998
7. The amount to be lost when burning (MKN) (%), shall not exceed	5.0	TCVN141:1998
8. The amount of sediment without dissolving (CKT) (%), not exceed	1.5	TCVN141:1998

2.3 Water

All water used for mixing and curing of concrete shall be supplied by the waterworks. Water from other sources may be used only if authorized by MOT after tests have shown the quality to be equal to or better than that supplied by the waterworks. Water from any source

which has been contaminated with dirt, oil, salt or other foreign substances shall not be used.

2.4 Fine Aggregate

(1) The fine aggregate for concrete shall consist of natural river sand or equivalent material.

(2) The fine aggregate shall be uniformly graded and shall meet the grading requirements as shown in the following Table.

Fine Aggregate

Sieve Designation	Percentage by Weight Passing square mesh sieve
(10.0 mm)	100
No. 4 (5.0 mm)	95 to 100
No. 16 (1.2 mm)	45 to 80
No. 50 (0.3 mm)	10 to 30
No. 100 (0.15 mm)	2 to 10

(3) The fine aggregate shall be stored in such a manner as to prevent mixture with other aggregate prior to the use and also to prevent inclusion of foreign materials.

2.5 Coarse Aggregate

(1) The coarse aggregate for concrete shall consist of crushed stones having hard, strong and durable pieces free from adherent coatings such as mud or other foreign materials. The coarse aggregate shall be graded between maximum sizes of 25 mm and minimum size corresponding to No. 4 (5 mm) sieve size. It must be free from dirt, floury stone dust, earth or any similar materials.

(2) The coarse aggregate shall be stored in such a manner as to prevent mixture with other aggregate prior to the use and also to prevent inclusion of foreign materials.

(3) Aggregate for Resurfacing

Aggregate for resurfacing shall be composed of crushed rock consisting of fragments of clean durable stone, free from thin and soft pieces, disintegrated rock, dirt or other foreign materials and shall satisfy the requirements of the authorities concerned.

2.6 Reinforcing Bar

Reinforcing bars shall be deformed steel bars. The bars shall be free from dirt, oil, paint, grease, thick rust and other defects, and shall conform to the following requirements:

1 Tensile stress at Minimum 440 N/mm2

2 Yield Point at Minimum 300 N/mm2