MINISTRY OF TRANSPORT
VIETNAM

STUDY FOR
ITS INTEGRATION PROJECT
IN NORTHERN AREA OF VIETNAM

APPENDIX 4

- BASIC DESIGN SPECIFICATIONS

NOVEMBER 2015

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
METROPOLITAN EXPRESSWAY CO., LTD.
NEXCO EAST ENGINEERING CO., LTD.
TRANSPORTATION RESEARCH INSTITUTE CO., LTD.
ABEAM CONSULTING LTD.

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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) 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) Axle Load Data Management
(22) Communication System
(23) Communication Duct
(24) Base Structure
(25) O&M Vehicle

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 allows receiving an emergency call for help at the Road Management Offices from an incident occurrence site. It also allows instantly sending instructions to the units concerned for clearing incidents and enforcing traffic regulations. It also allows using administrative telephone call among the Regional Main Center, the Road Management Offices, and the Toll Offices.

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, the Road Management Offices and the Toll Office of the expressway network for actualizing functional packages.

3. Relevant Regulations and Standards

- ITU-T Y. 1541: Network performance objectives for IP-based services
- ITU-T G711: Pulse Code Modulation (PCM) of Voice Frequencies
- ITU-T G165: Echo Cancellers
- 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
- ITU-T X.200, ISO/IEC 7498-1: Information Technology – Open Systems Interconnection – Basic Reference Model: The Basic Model (OSI Reference Model)
- IETF RFC 791: Internet Protocol (IP)
- IETF RFC 793: Transmission Control Protocol (TCP)
- IETF RFC 768: User Datagram Protocol (UDP)
- IETF RFC 894: A Standard for the Transmission of IP Datagrams over Ethernet Networks (IP over Ethernet)
- IETF REC 792: Internet Control Message Protocol (ICMP)
- IETF RFC 1157: Simple Network Management Protocol (SNMP)
- IETF, RFC 3261 SIP: Session Initiation Protocol
- IETF, RFC3262 Reliability of Provisional Responses in the Session Initiation Protocol (SIP)
- IETF, RFC 3263 Session Initiation Protocol (SIP): Locating SIP Servers
- IETF, RFC 3264 An Offer/Answer Model with the Session Description Protocol (SDP)
- IETF, RFC 3265 Session Initiation Protocol (SIP) – Specific Event Notification

- IETF, RFC 3550 RTP: A Transport Protocol for Real-Time Applications
- IETF, RFC 4566 SDP: Session Description Protocol
- BS 7430: Earthing
- BS 6651: Lightning Protection
- TCVN 8068: 2009 VoIP telephone service – Requirements
- TCVN 9385:2012 Protection of structures against lightning – Guide for design, inspection and maintenance

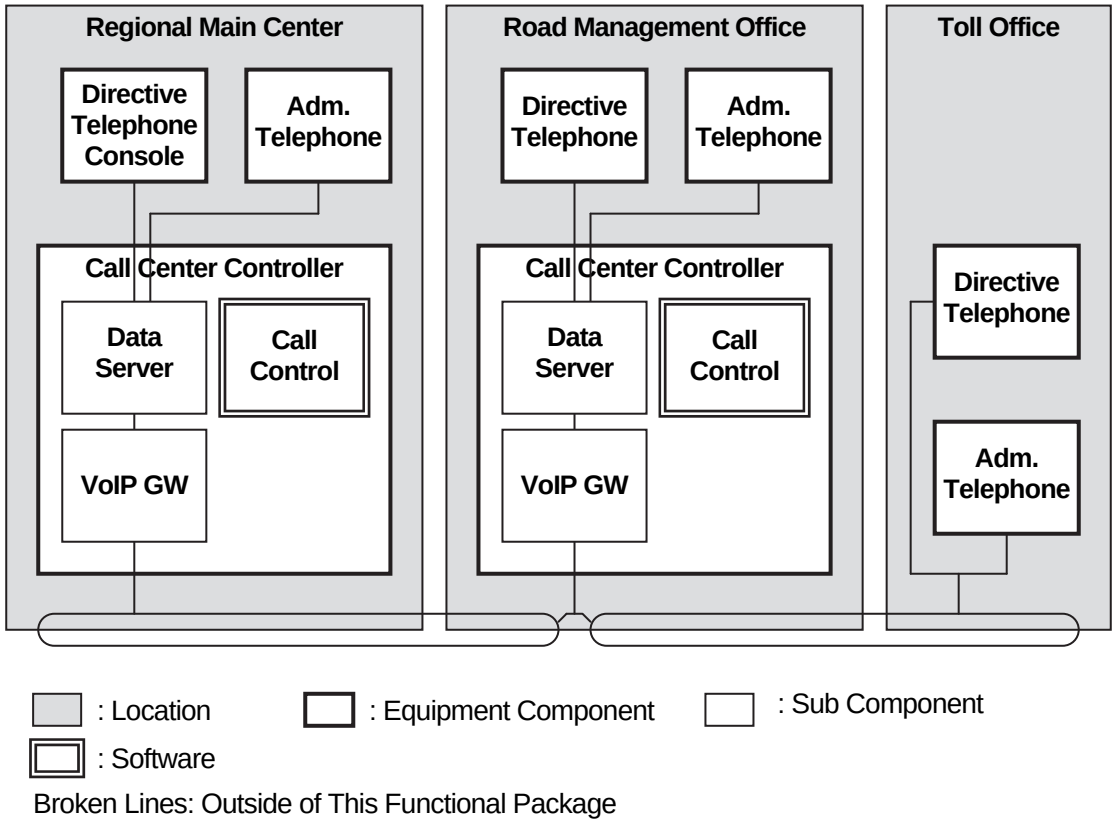
4. Requirements

- System shall be capable of receiving notification of incident occurrence promptly from road user.
- 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 the Regional Main Center, the Road Management Offices and the 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 30 minutes.
- System shall be capable of functioning 24 hours a day, 365 days a year by a redundant system.
- In case, part or whole of procurement and operation and maintenance related to the voice communication 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.
- The MOT shall be capable of instructing the manager of the system and of disclosing the specifications of the existing system in case there is an associated existing system.

5. System Architecture

System architecture for voice communication is shown below.

Figure 5.1 System Architecture for Voice Communication



6. Call Center Controller

6.1 Functions

(1) SIP Server

- The SIP Server shall be capable of connecting directive communication from directive communication console 100% without any calling loss within ITS related communication network.
- The SIP Server shall be capable of controlling call for directive and administrative telephone within ITS related communication network.
- The SIP Server shall be capable of securing one to many communications.
- The SIP Server shall be capable of functioning as proxy server which transmits connection request to another Server for Call Control when such request receives.
- The SIP Server 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 SIP Server shall be capable of controlling Quality of Service on voice communication within ITS related communication network.
- The SIP Server shall comply with the related international and Vietnamese standard.
- The SIP Server shall be those types whose usefulness have been confirmed by road operators, communication carriers or operators in the countries other than the country of manufacture.

(2) VoIP GW

- The VoIP GW shall connect telephones among the Regional Main Center, the Road Management Offices and the Toll Offices.
- The VoIP Gateway shall be capable of originating call from administrative telephone in the ITS communication network to PSTN and capable of receiving incoming call from PSTN to the administrative telephone in ITS communication network.
- The VoIP Gateway 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 VoIP Gateway shall be capable of resolving telephone number and IP address, and capable of connecting to the proper telephone terminal.
- The VoIP Gateway 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 VoIP Gateway shall be complied with the international standard.
- The fault of the VoIP Gateway shall be capable to be detected, and shall be notified to the operator. During emergency repairing time after detection of the system fault, continuous operation shall be secured with the redundant equipment component without any interruption.
- The VoIP Gateway shall be those types whose usefulness have been confirmed by road operators, communication carriers or operators in the countries other than the country of manufacture.

6.2 Structure

(1) SIP Server

- The SIP Server to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The SIP Server shall have necessary reliability to fulfil the specified MTBF in the following clause.
- The SIP Server shall have the structure which is possible to fix in the building in the Regional Main Center and the Road Management Offices.
- The structure of SIP Server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of SIP Server shall be capable to implement the periodical checking and cleanup activities.

(2) VoIP GW

- The VoIP GW to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The VoIP Gateway shall have necessary reliability to fulfil the specified MTBF in the following clause.
- The VoIP Gateway shall have the structure which is possible to fix in the building in the Regional Main Center and the Road Management Offices.
- The structure of VoIP Gateway shall be capable to replace the faulty parts simply and easily when it is detected.

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

6.3 Performance

(1) SIP Server

- The performance of SIP Server 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 comply with the conditions of Class 0 of ITU-T Recommendation Y.1541 within the communication network of ITS.
- The directive communication from the Regional Main Center shall connect without any connection loss. As for the Administrative Telephone, the connection loss shall be within 10% in the communication network of ITS.
- The Server shall have the following performance.
    - Number of CPU Core: Greater or equal 4 cores
    - Memory：Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 300 Gigabyte
    - Corresponding to the Hot Plug function
    - Power Consumption: maximum 800W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: rack mount
- Printer prints out required information in monochrome in A4 or A3 paper.
- 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.
- This equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

(2) VoIP GW

- The performance of VoIP Gateway 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 comply 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.
- VoIP GW shall support SIP protocol.
- VoIP GW shall support ITU-T Rec. G.711 as voice encoding law.
- VoIP GW shall support ITU-T Rec. G165 as echo canceller.
- VoIP GW shall support appropriate LAN interface such as 10Base-T/ 100 Base-TX.
- VoIP GW shall support TCP/IP and UDP/IP protocol.
- 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.
- This equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

6.4 Human Machine Interface

(1) SIP Server

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

(2) VoIP GW

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

(1) SIP Server

- The communication interfaces of the SIP Server shall comply with the international standard.
- The communication interfaces of the SIP Server shall not be hindrance of voice communication.

(2) VoIP GW

- The communication interfaces of the VoIP Gateway shall comply with the international standard
- The communication interfaces of the VoIP Gateway shall not be hindrance of voice communication.
- The Contractor shall prepare the detailed design of voice communication system including necessary voice interface connecting to PSTN. The number of administrative telephone is assumed as follows;
  - 20 sets for NRMC
  - 20 sets for one Road Management Office
  - 10 sets for one Toll Office.

6.6 Installation

(1) SIP Server

- 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 SIP Server shall be installed in air conditioned room in the Regional Main Center and the 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.
- In case that some parts of function required are realized by a software, the 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 earthing of lightning protection system and other earthing 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.

(2) VoIP GW

- 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 VoIP Gateway shall be installed in air conditioned room in the Regional Main Center and the 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.

- In case that some parts of function required are realized by a software, the 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 earthing of lightning protection system and other earthing 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. Call Center Controller (Call Control)

7.1 Functions

- The Call Center Controller shall be capable of functioning as registrar which manages users, IP addresses and telephone numbers.
- The Call Center Controller shall be capable of controlling the VoIP gateway.
- The fault of the SIP Server shall be capable to be detected, and shall be notified to the operator. During emergency repairing time after detection of the system fault, continuous operation shall be secured with the redundant equipment component without any interruption.

7.2 Performance

- The system shall be capable of requesting from an IP address of the receipt of a message by doing the inquiry to a place server as a key with receipt of a message address included in the SIP header, and shall be capable of deciding the forwarding address of the message based on it.
- The system shall be capable of solving the next forwarding address of the SIP request, and shall be capable of sending the forwarding address by a reply.
- The system shall be capable of registering the contact address with a place server based on a message from User Agent.
- When a User Agent is connected to the network, the system shall be capable of sending out REGISTER message at a certain distance.
- The system shall be capable of managing the place on the network where there is User Agent.

7.3 Human Machine Interface

- The setting screen shall have user-friendly interface.

7.4 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 disclosed in order to secure the interoperability of devices.

7.5 Installation

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

8. Directive Telephone 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 Telephone Console.
- There are several types of directives from the Regional Main Center: directive to all, directive to concern the Road Management Office and directive to the specific region(s), and directive to specific offices including the 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 operator. 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 country of manufacture.

8.2 Structure

- The directive communication console equipment component to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The directive telephone console equipment component shall have necessary reliability to fulfil the specified MTBF in the following clause.
- The directive communication console equipment component shall be capable to install 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 cleanup 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.
- This equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

8.4 Human Machine Interfaces

- The directive communication console at the 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 the Regional 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 the 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.
- In case that some parts of function required are realized by a software, the 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 earthing of the lightning protection system and other earthing 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 the Regional Main Center shall be equipped to issue notification alert to the operator 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 operator 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 to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.

- The directive telephone equipment component shall have necessary reliability to fulfil the specified MTBF in the following clause.
- 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.
- This equipment component's min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

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 the Regional Main Center, the Road Management Offices, and the 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 earthing of the lightning protection system and other earthing 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, the 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 to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The administrative telephone equipment component shall have necessary reliability to fulfil the specified MTBF in the following clause.

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 least 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.
- This equipment component's min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

10.4 Human Machine Interfaces

- The key arrangement of administrative telephone equipment components shall be as per the descriptions of 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.

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 the Regional Main Center, the Road Management Offices, and the 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 earthing of the lightning protection system and other earthing 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 nominal characteristics of the main supply are 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 minimum 2 hours.
- The electric power supply for voice communication related equipment component shall equip 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 network management system (NMS) shall be capable to identify the faulty equipment component easily.
- 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 DRVN.
- 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 is recommended to make a contract with the DRVN 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 as a part of the tender or prequalification proposal.

15. 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection, unit inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

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

(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 DRVN 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 DRVN and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of

authorized staff of DRVN and/or the consultant.

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

(9) Prior to handover, the DRVN, PMU3, responsible organization of O&M of the equipment components, the consultant and the related party will inspect all equipment components at roadside, the Regional Main Center and the Road Management Offices in order to verify the quantity of the equipment components with the contract conditions. The Contractor shall show each equipment component at site and shall bear the necessary cost of this inspection.

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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

The following conditions shall be as per the related clauses of the contract conditions;

(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 DRVN and the consultant

(4) The necessary number of submission of documents

(2)
CCTV Monitoring

1. General Outline

This functional package allows the road operators to capture the current situation of traffic accidents, breakdown vehicles, left obstacles, reverse driving, vandalism, flood, road damage, natural disaster and traffic conditions on the expressways and to monitor the captured video image at the Regional Main Centre and the Road Management Offices by using cameras installed at the bottleneck spots on expressway where traffic flow can easily be stuck by incidents.

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 and the 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

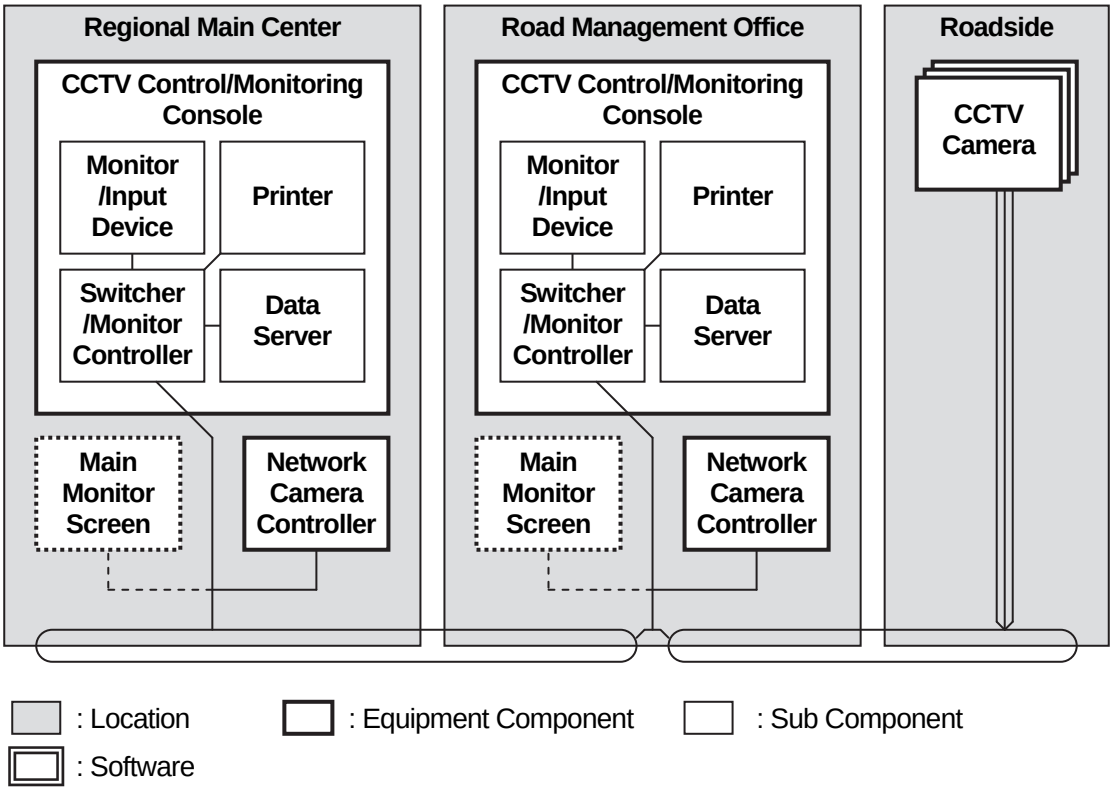
4. Requirements

- System shall be capable of recognizing incident occurrences on the road and their type by using cameras located at every 2km or less along the through lanes of expressways and controlled/monitored remotely from the Regional Main Center and the Road Management Office; the incidents shall include traffic accidents, breakdown vehicles, left obstacles, reverse driving, vandalism, flood, natural disaster, fire, road damage, and traffic congestion.
- System shall be capable of recognizing the severity of incidents through identifying types of vehicles involved (such as trucks, buses and sedans) and identifying smoke or fire by appearance.
- System shall be capable of identifying the place of incident occurrence at the Regional Main Center and the Road Management Office.
- System shall be capable of installing roadside equipment for the monitoring to through lane of Expressway in continuity.
- System shall be capable of installing roadside equipment at the bottleneck spots on Expressway where traffic flow can easily be stuck by incidents.
- System shall be capable of controlling roadside equipment remotely from the Regional Main Center in real time and from the Road Management Office at an occurrence of incident.
- 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, such as the video image of traffic accident occurrence.
- System shall be capable of indicating, output the needed data (soft copy) and printing out the needed results.
- System shall be capable of saving implementation cost by utilizing internet technologies.
- The MOT shall be capable of instructing the manager of the system and of disclosing the specifications of the existing system in case there is an associated existing system.

5. System Architecture

System architecture for CCTV monitoring is shown below.

Figure 5.1 System Architecture for CCTV Monitoring



Broken Lines: Outside of This Functional Package

6. CCTV Camera

6.1 Functions

- CCTV camera shall be capable of monitoring vehicles on the expressway and identify types of the vehicles by their appearance.
- CCTV camera shall be capable of making 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.
- CCTV camera shall be capable of synchronizing 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 camera shall be capable of correcting brightness of captured image automatically. (This is called the iris function.)
- CCTV camera 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 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 system shall be capable of fully meeting the requirements even under night conditions.
- The Fixed camera must be capable of complying with CS–mount standards.

6.3 Performance

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

- PTZ (Panning/Tilting/Zooming) 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 requirements 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 Color image and Black/White image in night mode for continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The equipment component shall be complied with ONVIF (Open Network Video Interface Forum) and/or to be supplied with Device Driver for controlling camera functions.
- The equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

Detailed specification of PTZ Type camera:

- Size of image CMOS / CCD sensor must be greater than or equal to 1/3".
- Scanning mode shall be progressive scan.
- Minimum focal length of lens must be between 3.0mm and 5.0mm.
- The camera resolution must be greater than or equal to 2 mega pixels or 1920 x 1080.
- The minimum illumination in day mode and night mode should be lower than or equal to 0.5 lux (Color: day mode) and 0.1 lux (Black / White: night mode) respectively, without slow shutter function.
- The camera must be capable of encoding in H.264 (MPEG-4 Part 10/AVC) and Motion JPEG.
- The camera shall be protected in accordance with IP66, ISO/IEC 60529 or equivalent.
- The camera must be able of panning at least 350 degrees and tilt 100 degrees.
- The camera must be equipped zooming function more than or equal to x20 optical zooming.
- The frame rate should be greater than or equal to 25 fps
- The camera must consumed power less than or equal to 100W

- The camera can operate at -30 to 50 degrees Celsius with humidity range from 20 to 80% (non-condensing).
- The maximum surveillance range should be greater than 1000m by using PTZ function in ideal condition.
- The camera shall be protected for the water droplets on dome which is blurring the field of view.
- The device's weight should be less than 6.0 kg.

Detailed specification of Fixed Type camera:

- Size of image CMOS / CCD sensor must be greater than or equal to 1/3".
- Minimum focal length of lens must be between 2.0mm and 5.0mm, and capable of change by using CS mount lens.
- The camera resolution must be greater than or equal to 2 mega pixels or 1920 x 1080. And, be capable of outputting smaller resolution images when the camera is utilized for image recognition.
- The minimum illumination in day mode and night mode should be lower than or equal to 0.3 lux (Color: day mode) and 0.1 lux (Black / White: night mode) 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 or equivalent.
- The frame rate should be greater than or equal to 25 fps.
- The camera must consumed power less than or equal to 30W.
- The camera can operate at -30 to 50 degrees Celsius with humidity range from 20 to 80% (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.

6.4 Human Machine Interfaces

- CCTV camera shall have the function to output test images to personal computers at site so that installation staff may adjust the direction of the camera to refer the images.
- 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 shall use 10BASE-T/100BASE-TX PoE Plus interfaces accordance with IEEE 802.3at.
- Fixed Type camera: The camera shall use 10BASE-T/100BASE-TX PoE Plus interfaces accordance with IEEE 802.3at.
- Necessary communication interface information and 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 around the ramp so as to monitor the 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, over bridges, 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 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 adjustable, and shall be fixed

appropriately.

- 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.
- CCTV camera shall be protected for the water droplets on dome which is blurring the field of view.
- 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 to consideration of the existing facilities. The detailed drawing shall include cabling and wiring diagram.
- In case the equipment 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 around merging and divergent section.

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.

- Installation Point of PTZ type camera shall be adjusted based on actual conditions based on site survey by bidder, and shall be get approval from supervisor

  - PTZ type camera need to be installed in case of disrupting vision obstacles such as Flyover Bridge, longitudinal gradient of road, roadside cutting slope, over bridges, 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 continuously 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:

- Installation Point of PTZ type camera shall be adjusted based on actual conditions based on site survey by bidder, and shall be get approval from supervisor :
- PTZ type cameras should be installed according to junction and interchange type. Each type requires different location of PTZ camera 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, over bridges, 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:

- Installation Point of Fixed type camera installation shall be adjusted based on actual conditions based on site survey by bidder, and shall be get approval from supervisor :
- Fixed type camera should be installed to monitor each ramp of the junction or interchange, such as around merging and divergent section.
- 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, over bridges, buildings, trees, lighting poles, traffic signs, VMS, alignment of road, tollgate, etc.

7. Network Camera Controller

7.1 Functions

- The Network Camera controller shall be capable of controlling CCTV cameras functions such as zooming, panning and tilting.
- The Network Camera controller shall be capable of being transferred the CCTV control ownership between with “Regional Main Center” and “Road Management Office” depending on the priority interrupt function.

- The system shall be capable of synchronizing its clock to the clock of "Network Camera Controller" at the Regional Main Center at start-up.
- The Network Camera controller can record simultaneously and give remote access of live video streams from CCTV cameras.

7.2 Structure

- The equipment components shall have robust structure, shape, size, and lightweight.
- The equipment components shall be equipped with the 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 the interference from other electronic devices

7.3 Performance

- The Network Camera controller complies with H.264 (MPEG-4 Part 10/AVC), MPEG4-Part2 and Motion JPEG video compression.
- The Network Camera controller shall operate with more than or equal to 1920 x 1080 resolution, less than or equal to 6Mbps bit rate and over or equal to 25 fps frame rate.
- The Network Camera controller may have recording unit with: At least or equal to 1 mega pixel resolution; More than or equal to 5 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 Network Camera controller shall comply with ONVIF (Open Network Video Interface Forum) standard.
- The equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

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 satisfied that operator sitting at the console 5m away from the main screen at the 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 the 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 with 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 equipment components shall comply with ONVIF (Open Network Video Interface Forum) standard
- 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 communication interface information and 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

- In case that some parts of function required are realized by a software, the 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 equipment estimated to install depends on the number of cameras and the number of interfaces on 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 equipment as joystick, keyboard, and 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 robust structure, shape, size, and lightweight.
- The equipment components shall be equipped with the 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 arising from inside equipment.
- The equipment components shall be protected with the 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.) greater than or equal to 20 inches.
- The CCTV Monitoring Console shall have the following performance.
    - Number of CPU Core: Greater or equal 4 core
    - Memory: Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 1 Terabyte
    - Power Consumption: less than 700W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: Tower style

- The Printer shall print required information by a color with A4 or A3 paper.
- All camera images shall be capable of being displayed on Monitor Screen for the operator to monitor the traffic conditions.
- However, some issues are envisioned as follows:
  - The room space may not be enough area to locate all necessary Monitor Screens.
  - The number of operators is not enough numbers for monitoring all CCTV images displayed on Monitor Screens.

  Therefore, number of monitors shall be complied 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 time interval.
- The system shall be capable of displaying the retrieve results which is retrieved images 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.
- The equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

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 the printer.
- The system shall be capable of printing displayed images by using the printer.
- The monitor in the console shall be greater than or equal to 20 inches so that operators at the 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 communication interface information and 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

- In case that some parts of function required are realized by some pieces of software, the 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 the Road Management Office.
- In case the equipment 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. However, if it is defined for each equipment on requirement specification then shall be in accordance with the conditions.

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

10. Power Supply

- The nominal characteristics of the main supply are 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 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 DRVN, 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 DRVN, 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and

the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN 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, left obstacles, reverse driving, vandalism and natural disaster on the expressways and to send notification to the Regional Main Center and the Road Management Offices by image analysis from cameras installed at the bottleneck spots on expressway where traffic flow can easily be stuck by incidents and at long tunnel sections incident.

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)
- IEC 60529: Degrees of Protecton provided by Enclosure (IP Code)

2) National Standards

- TCVN4054:2005 , Motorway - Requirements KEH
- TCVN5729

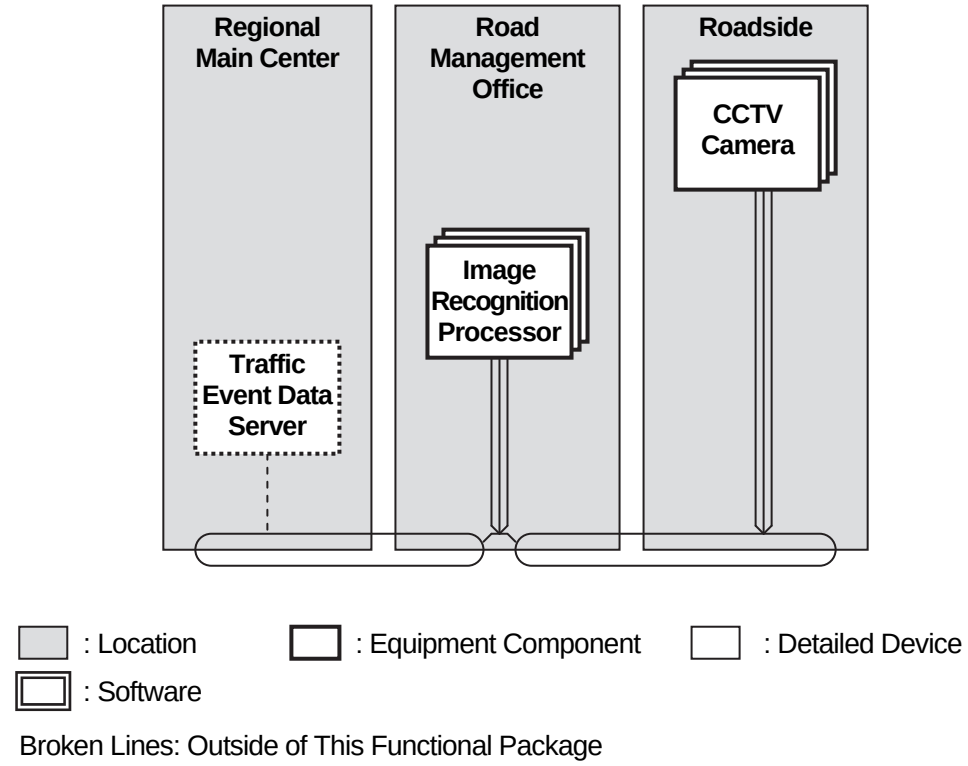
4. Requirements

- System shall be capable of automatically and promptly detecting incident occurrences and their types by using cameras located at each ramp of interchange/junction by image analysis, the incident shall include traffic accidents, breakdown vehicles, left obstacles, reverse driving, vandalism and natural disaster.
- System shall be capable of notifying the detected results automatically and promptly to the Regional Main Center and the Road Management Office.
- System shall be capable of monitoring original video image remotely at the Regional Main Center and the Road Management Office.
- System shall be capable of identifying the time and place of incident occurrence at the Regional Main Center and the Road Management Office.
- System shall be capable of allowing installing roadside equipment adequately location at the bottleneck spots on Expressway where traffic flow can easily be stuck by incident and at tunnel section incidents.
- System shall be capable of minimizing load caused by data transmission, including video image on the communication system.
- The MOT shall be capable of instructing the manager of the system and of disclosing the specifications of the existing system in case there is an associated existing system.

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

- CCTV Camera shall be capable of monitoring vehicles on the expressway and identifying types of the vehicles by their appearance.
- CCTV Camera shall be capable of correcting brightness of captured image automatically. (That is called as the function of iris.)
- CCTV Camera shall be capable of having auto-focus function to be controlled by using "CCTV Monitor Console".
- CCTV Camera shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- CCTV Camera shall be capable of synchronizing its clock to the clock of "Traffic Event Data Server" at start-up.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

6.2 Structure

- The camera shall be protected with measures against typhoon, fire, earthquake, sandstorm, and lightning.
- The camera shall be protected with measures against water, rust, dust, salt water in case those equipment components are installed outdoors.
- The chassis of camera shall not be opened easily, and its door shall have a lock.
- The camera 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 camera shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The camera shall be protected with 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 must be capable of complying with CS–mount standard.
- The camera shall be capable of fully meeting the requirements even under night conditions.
- The equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

6.3 Performance

- The camera 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 camera 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 camera shall be capable of taking images road traffic by at least Color image and Black/White image in night mode for continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The camera shall be complied with ONVIF (Open Network Video Interface Forum) and/or to be supplied with Device Driver for controlling camera functions.
- Size of image CMOS/CCD sensor must be greater than or equal to 1/3".
- Minimum focal length of lens must be between 2.0mm and 5.0mm, and capable of change by using CS mount lens.
- The camera resolution must be greater than or equal to 2 mega pixel or 1920x1080. And be capable of outputting smaller resolution images when the camera is utilized for image recognition.
- The minimum illumination in day mode and night mode should be lower than or equal to 0.3 lux (Color: day mode) and 0.1 lux respectively (Black/White: night mode), 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 or equivalent.
- The frame rate should be greater than or equal to 25 fps.
- The camera must consumed power less than or equal to 30W.
- The camera can operate at -30 to 50 degrees Celsius with humidity range from 20 to 80% (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.

6.4 Human Machine Interfaces

- The camera shall have the function to output test images to personal computers at site so that installation staff may adjust the direction of the camera to refer images.
- 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 functions of the camera shall be controlled remotely by using a keypad at the console in the Regional Main Center. The camera control shall be conducted using IP address

corresponding to the camera identification number.

6.5 Communication Interface

- The camera shall provide control signal for image transmitting over TCP/IP.
- The camera 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 communication information and 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 camera shall be appropriately installed at locations where incident possibility is high: Junctions and Interchanges.
- Fixed type camera should be installed to monitor each ramp of the junction or interchange.
- Fixed type cameras should 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 5 m above ground level in accordance with the limit construction clearance in accordance with TCVN 4054:2005 and TCVN 5729.
- Roadside equipment shall be installed so as not to obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- CCTV camera shall be installed so that images may not swing by strong wind.
- Horizontal and vertical angle of the camera shall be adjustable, and shall be fixed appropriately.
- The camera shall be capable of being vertically and horizontally adjusted during installation at roadside.
- In case of more than one camera are attached on the same pole, each camera shall be attached with at least 1m height interval.
- Installation Point of CCTV camera shall be adjusted based on actual conditions based on

site survey by the contractor, and shall be get approval from supervisor.

- The angle of view of a camera shall be adjusted for monitoring the road continuously in consideration of the site survey by the contractor.
- 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 equipment to be located at outdoor, the screw for attachment should be antitheft type.
- 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't not access to the equipment component easily.

7. Image Recognition Processor

7.1 Functions

- The processor shall be capable for recognition of the following Traffic Events occurrences on the expressway automatically from images of CCTV camera. The results of recognition are to be transmitted to "Traffic Event Data Server".

  <Traffic Events>
  - Stopped Vehicle
  - Indirection Vehicle
  - Speed drop
  - Traffic Congestion
  - Under / Over Speed

- The processor 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 processor shall be protected with measures against lightning.
- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm in case the equipment components are installed outdoors.
- The equipment components shall be protected with the measures against water, rust, dust, salt water in case the equipment components are installed outdoors.
- The chassis of processor shall not be opened easily, and its door shall have a lock.
- The chassis of processor shall be capable of dissipating temperature rising from inside equipment.
- The processor shall be protected with measures against interference from other electronic devices.
- The structure of processor shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of processor shall be capable to implement the periodical checking and clean-up activities.
- The processor capable of installed or assembled on CCTV camera, it is accordance with the proposal by the contractor.

7.3 Performance

- Distance of Recognition: equivalent to Installation height of CCTV x 10 times or more, and more or equal to 150m.
- The processor shall be capable of transmitting the recognized Traffic Events and Incident Occurrence 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 such as table below.

Table 7.1 Item for Incident Report

Data Elements	Type
Road Management Office ID	INT*
Road Section ID	INT*
Lane ID	INT*
Place ID	INT*
Beginning Kilometer Post	TXT
Ending Kilometer Post	TXT
Incident Status	INT*
Date/Time	Datetime

Table 7.2 Item for Traffic Event Report

Data Elements	Type
Traffic Event Data ID	INT
Road Management Office ID	INT*
Road Section ID	INT*

Road Link ID	INT*
Lane ID	INT*
Place ID	INT*
Traffic Event Category ID	INT*
Traffic Event Class ID	INT*
Causal Traffic Event Data ID	INT
Beginning Kilometer Post	TXT
Ending Kilometer Post	TXT
Input Person	TXT
Event Status	TXT
Main Center Check Status	INT*
Road Management Office Check Status	INT*
Status of Traffic Event	INT*
Date/Time End	TXT
Date/Time	Datetime

Table 7.3 Item for Traffic Congestion Report

Data Elements	Type
Road Management Office ID	INT*
Cumulative Number of Vehicles	INT*
Average Vehicle Speed	INT*
Traffic Congestion Status	INT*
Beginning Kilometer Post	TXT
Ending Kilometer Post	TXT
Date/Time	Datetime

- The processor shall be capable of digitising and outputting the reliability of recognition result which represents the accuracy of the recognition results.
- 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 processor 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.

7.4 Communication Interface

- The processor 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 communication interface 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

- Image recognition can be installed the camera with fully meeting with the requirement specification.
- The total number of equipment estimated to install depends on the number of cameras for using Event Detection.
- In case that some parts of function required are realized by some pieces of software, 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: However, if it is defined for each equipments on requirement specification then shall be in accordance with the conditions.

For Regional Main Center, Road Management Office, Toll Management Center, and Toll Office

Temperature: 25 +/- 3 degree Celsius in average

Relative humidity: between 20 and 80 % in average

For outside

Temperature: between - 0 and +50 degree Celsius

Relative humidity: below 95 %

- It is recommended that the lighting condition of 200 lux is provided to allow easy operation and maintenance in the Regional Main Center.

9. Power Supply

- The nominal characteristics of the main supply are 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 DRVN, 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 DRVN, 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN 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, large vehicle ratio and vehicle velocity on the expressways, and to recognize vehicle number plate, to convert textural information 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

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)
- 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

2) National Standards

- TCVN4054:2005 , Motorway - Requirements KEH
- TCVN5729

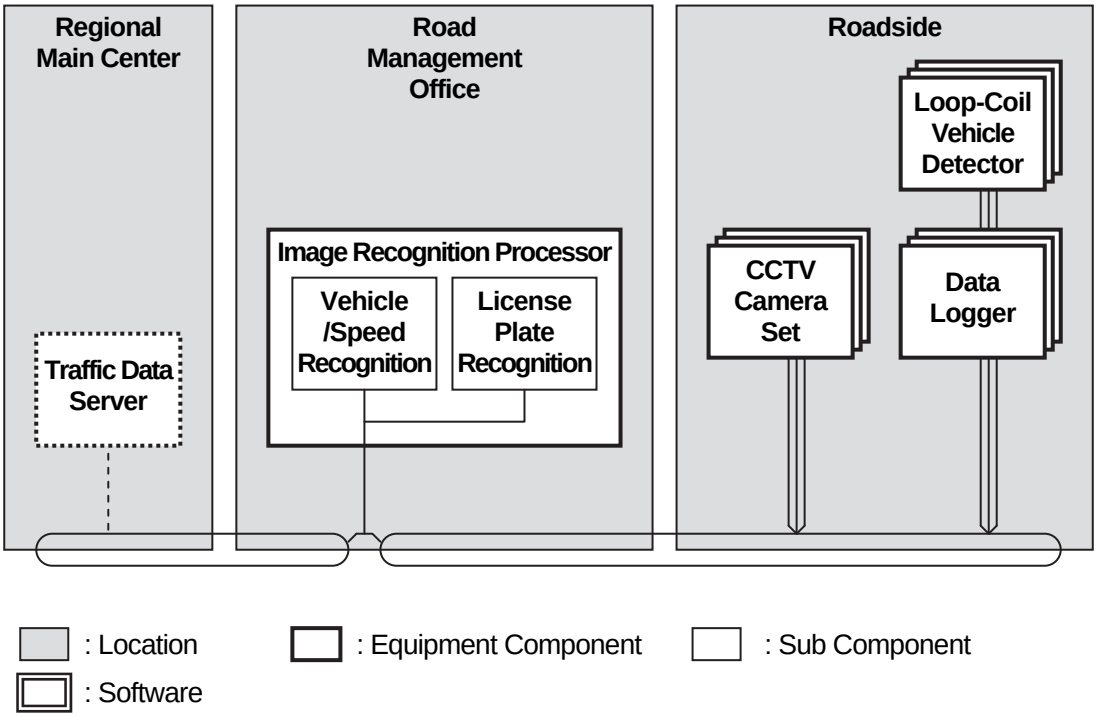
4. Requirements

- System shall be capable of measuring, number of vehicles and vehicle speed at the midway point between the pair of adjacent interchanges and at the other specific point on the expressway network.
- System shall be capable of recognizing vehicle number plate, to convert textural information.
- System shall be capable of storing the image and textural information of vehicle number plate with each vehicle speeds, in case the over speed vehicle.
- System shall be capable of measuring, number of vehicles by Trailers, Semi-Trailers and another type of vehicle by using number plate information.
- System shall be capable of notifying the measured results automatically and promptly to the Regional Main Center and the Road Management Office.
- System shall be capable of identifying the time and place of the measured values at the Regional Main Center and the Road Management Office.
- System shall be installed at the point where is traffic flow is sorted, shall NOT be installed at near the diversion / merging point and the sharp bend section.
- System shall be capable of minimizing load caused by data transmission, including video image on the communication system.
- The MOT shall be capable of instructing the manager of the system and of disclosing the specifications of the existing system in case there is an associated existing system.

5. System Architecture

System architecture for vehicle detection is shown below.

Figure 5.1 System Architecture for Vehicle Detection



6. Loop-coil Vehicle Detector

6.1 Functions

- The loop-coil vehicle detector 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 every 5 minute)

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

  - Vehicle Length

- The loop-coil vehicle detector shall be capable of transmitting the measured data to “Traffic Data Server”.
- The loop-coil vehicle detector shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The loop-coil vehicle detector shall be capable of synchronizing 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.

6.2 Structure

- 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 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).

- The equipment component's min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

6.4 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.

6.5 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 communication interface information and 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.

6.6 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. Data Logger

7.1 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 Traffic Data Server.
- If the 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 Traffic Data Server.
- The data logger shall be capable to detect the failure of the 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.

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, 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.

7.3 Performance

- The data logger shall be capable to perform necessary functions stipulated in required functions.
- 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 Traffic Data Server and the sensor which is equipped with its own clock.
- The equipment component's min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

7.4 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 the sensors and its own operating conditions, and screen which displays the result.
- The data logger shall be capable to check the sensor and its own operating conditions through input devices, and shall be capable to display the result on screen.

7.5 Communication Interfaces

- The system shall be capable of transmitting all data and signals over TCP/IP between data logger and Traffic 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.
- Necessary communication interface information and 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.
- 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't access to the equipment component easily.

8. CCTV Camera Set

8.1 Functions

(1) CCTV Camera for Vehicle Detection

- The system shall be capable of monitoring vehicles on the expressway and identifying types of the vehicles by their appearances.
- 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.
- To synchronize its clock to the clock of “Traffic Event Data Server” at start-up.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

(2) CCTV Camera for License Plate Detection

- 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 without control signal for the trigger of taking an image by using additional sensor.
- 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.
- To synchronize its clock to the clock of “Traffic Event Data Server” at start-up.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

8.2 Structure

(1) CCTV Camera for Vehicle Detection

- The equipment components shall have robust structure, shape, size, and lightweight.
- 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.
- The system shall be capable of fully meeting the requirements even under night conditions.

(2) CCTV Camera for License Plate Detection

- The equipment components shall have robust structure, shape, size, and lightweight.
- 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 system shall be capable of fully meeting the requirements even under night conditions.

8.3 Performance

(1) CCTV Camera for Vehicle Detection

- 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 Color image and Black/White image in night mode for continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The equipment component shall be complied with ONVIF (Open Network Video Interface Forum) and/or to be supplied with Device Driver for controlling camera functions.
- Size of image CMOS / CCD sensor must be greater than or equal to 1/3".
- Minimum focal length of lens must be between 2.0mm and 5.0mm, and capable of change by using CS mount lens.
- The camera resolution must be greater than or equal to 2 mega pixels or 1920 x 1080. And, be capable of outputting smaller resolution images when the camera is utilized for image recognition.
- The minimum illumination in day mode and night mode should be lower than or equal to 0.3 lux (Color: day mode) and 0.1 lux respectively (Black / White: night mode), 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 or equivalent.

- The frame rate should be greater than or equal to 25 fps.
- The camera must consumed power less than or equal to 30W.
- The camera can operate at -30 to 50 degrees Celsius with humidity range from 20 to 80% (non-condensing).
- The maximum surveillance range should be greater than 150m without panning, tilting, and zooming functions.
- The equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

(2) CCTV Camera for License Plate Detection

- 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 minimum illumination should be lower than or equal to 0.0 lux respectively (Black / White: night mode), without slow shutter function. However, additional LED lighting is acceptable.
- The camera shall be protected in accordance with IP66, ISO/IEC 60529 or equivalent.
- The camera can operate at -30 to 50 degrees Celsius with humidity range from 20 to 80% (non-condensing).
- The camera capable of taking an image of licence plate number clearly, in case of the vehicle speed is over or equal to 180km/h.
- The equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

8.4 Human Machine Interfaces

- CCTV camera shall have the function to output test images to personal computers at site so that installation staff may adjust the direction of the camera to refer the images.
- 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 functions of the CCTV cameras shall be controlled remotely by using a keypad at the console in the Regional Main Center. The camera control shall be conducted using IP address corresponding to the camera identification number.

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
- The camera should use 10BASE-T/100BASE-TX interfaces.
- Necessary communication interface information and 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

- 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.
- 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 5m 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, over bridges, buildings, trees, lighting poles, traffic signs, VMS, alignment of road, tollgate, etc.
- Installation Point of the camera shall be adjusted based on actual conditions based on site survey by the contractor, and shall be get approval from supervisor.
- The angle of view of the camera shall be adjusted for monitoring the road continuously in consideration of the site survey by the contractor.
- The equipment components shall be appropriately installed at interval locations between interchanges and junctions.

- The cameras shall be installed with the maximum surveillance area to shoot the image of vehicles
- In case the equipment 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 to 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't not access to the equipment component easily.

9. Image Recognition Processor

9.1 Functions

(1) Vehicle Count/Speed Recognition

- The equipment components shall be capable for recognition of the following Traffic Data on the expressway automatically from images of CCTV camera. The results of recognition are to be transmitted to "Traffic Data Server".
  - Traffic Volume (by all lanes, by one lane, by vehicle category and by hour)
  - Average Vehicle Speed (for every 1 minute, 15 minutes, and 1 hour)
  - Occupancy
  - Traffic Flow Speed
  - Vehicle Speed (by each vehicle)
- 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.

(2) License Plate Recognition

- The equipment components shall be capable for recognition of the following Traffic Data on the expressway automatically from images of CCTV camera. The results of recognition are to be transmitted to “Traffic Data Server”.
  - Vehicle Speed (by each vehicle)
  - Number Licence Plate Information in Text Data
- 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

(1) Vehicle Count/Speed Recognition

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm, in case the equipment components are installed outdoors.
- The equipment components shall be protected with the measures against water, rust, dust, salt water, in case the equipment components are installed outdoors.
- 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 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.
- The Image Recognition Processor capable of installed or assembled on CCTV camera, it is accordance with the proposal by the contractor.

(2) License Plate Recognition

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm, in case the equipment components are installed outdoors.
- The equipment components shall be protected with the measures against water, rust,

dust, salt water, in case the equipment components are installed outdoors.

- 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 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.
- The Image Recognition Processor capable of installed or assembled on CCTV camera, it is accordance with the proposal by the contractor.

9.3 Performance

(1) Vehicle Count/Speed Recognition

- Distance of Recognition: equivalent to Installation height of CCTV x 10 times or more, and more or equal to 150m.
- The equipment components shall be capable of transmitting the measured Traffic Data to “Traffic Data Server”.
- The equipment of components shall be capable of discretionarily setting the unit time of recording volume, average speed, occupancy, traffic flow speed, and vehicle 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 equipment component’s min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

(2) License Plate Recognition

- The equipment components shall be capable of recognized all type of the Vietnamese license number plate in accordance with the latest Vietnamese law of the license number plate, such as Circular No.15/2014/TT-BCA.
- The equipment components shall be capable of recognized the license number plate on the vehicle which is running in more or equal to 180km/h.

- The equipment components shall be capable of digitising and outputting the reliability of recognition result which represents the accuracy of the license number plate recognition results.
- 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 Data Server”.
- The equipment components shall be capable of transmitting the measured Traffic Data to “Traffic Data Server”.
- The equipment components 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 equipment component’s min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

9.4 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 communication interface 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.

9.5 Installation

- Image recognition can be installed into the camera with fully meeting with the requirement specification.
- The total number of equipment estimated to install depends on the number of cameras for using Vehicle Detection and License Number Plate recognition.
- In case that some parts of function required are realized by some pieces of software, 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.
- The Image Recognition Processor capable of installed or assembled on CCTV camera, it is accordance with the proposal by the contractor.

10. 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. However, if it is defined for each equipment on requirement specification then shall be in accordance with the conditions.

  For Regional Main Center, Road Management Office, Toll Management Center, and Toll Office

  Temperature: 25 +/- 3 degree Celsius in average

  Relative humidity: between 20 and 80 % in average

  For outside

  Temperature: between - 0 and +50 degree Celsius

  Relative humidity: below 95 %
- It is recommended that the lighting condition of 200 lux is provided to allow easy operation and maintenance in the Regional Main Center.

11. Power Supply

- The nominal characteristics of the main supply are 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.

12. 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 DRVN, 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 DRVN, 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 the 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and

the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN and the consultant

(4) The necessary number of submission documents

(5)
Traffic Analysis

1. General Outline

This functional package allows the road/traffic 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 Regional Main Centre 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

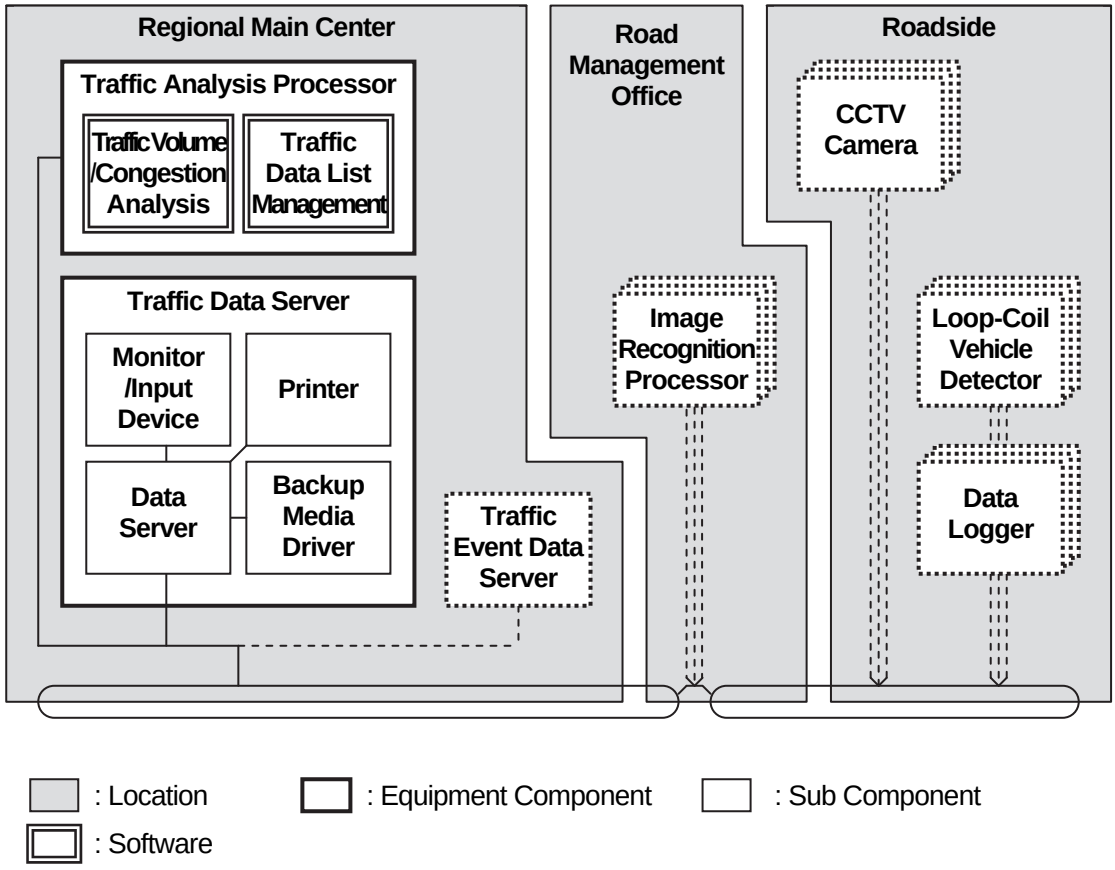
4. Requirements

- System shall be capable of calculating the traffic volume of each vehicle size (large vehicle and normal vehicle) on expressway based on the results obtained from Vehicle Detection installed in appropriate points.
- System shall be capable of calculating the average speed and traffic congestion status with the precision usable for traffic information provision based on the results obtained from Vehicle Detection installed in appropriate points.
- System shall be capable of analyzing the traffic by empirical technique proved in a network of expressways.
- System shall be capable of compiling the calculation results and the measured results by vehicle detectors as statistic values.
- System shall be capable of displaying the result of traffic analysis based on measured value of vehicle detectors.
- 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 printout (and also output as electronic data) about the needed results.
- The MOT shall be capable of instructing the manager of the system and of disclosing the specifications of the existing system in case there is an associated existing system.

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/Congestion Analysis)

6.1 Functions

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

6.2 Performance

- The system 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.
- The system 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.
- The system shall be capable of automatically updating the traffic data (such as 5 minutes traffic volume, 15 minutes traffic volume) every 1 minute.
- The system 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 system 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

- The system 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.
- The system 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.
- The system 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
- The system 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).
- The system shall be capable of displaying the calculated results of traffic data into table and chart formats.
- The system shall be capable of transmitting the calculated result of traffic data to "Traffic Event Data Server".
- The system 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).

6.3 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.
- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the

screen specifications which a contractor makes and it shall be approved by the client.

6.4 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.

6.5 Installation

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

7. Traffic Analysis Processor (Traffic Data List Management)

7.1 Functions

- The system shall be capable of receiving, compiling and managing the Traffic data relating to image recognition from each Vehicle Detection.

7.2 Performance

- The system 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.
- The system shall be capable of automatically updating the average speed every 1 minute. And also identifying heavy traffic every 1 minute.
- The system shall be capable of displaying the calculation result of average speed of each specific point into table and chart formats.
- The system shall be capable of transmitting the calculation result of traffic data to “Traffic Event Data Server”.
- The system 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).

7.3 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.

- The system 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

- The system 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

7.4 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.

7.5 Installation

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

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.
- The Traffic Data Server shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period and power outage period.

8.2 Structure

- The server shall be protected with measures against lightning.

- The chassis of server shall not be opened easily, and its door shall have a lock.
- Chassis of server shall be capable of dissipating temperature rising from inside equipment.
- The server shall be protected with measures against interference from other electronic devices.
- The server shall have the structure which is possible to fix in the building in the Regional Main Center.
- The structure of server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the server shall be capable to implement the periodical checking and clean up activities.

8.3 Performance

- The server 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.
- The server shall have storage capacity to store at least five (5) years data on traffic volume, average speed, and congestion condition.
- The 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 have the following performance.

  - Number of CPU Core: Greater or equal 4 cores
  - Memory：Greater or equal 8 Gigabyte
  - Hard Disk Drive: Greater or equal 300 Gigabyte
  - Corresponding to the Hot Plug function
  - Power Consumption: less than 800W
  - System Inlet Temperature: 5 – 35 °C
  - Relative Humidity: 15 – 85%

- Type: rack mount

- The server (Blade Server) shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).
- The 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 server shall be capable of executing the restoration of backup 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 back up 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 server shall be capable of displaying the retrieved results on the monitor screen by operation PC.
- The server shall be capable of printing information which is displayed on Monitor Screen by operation PC.
- Recommended size of monitor screen shall be (approx.) 20 inches or over.
- All consoles shall have user-friendly interface.
- Printer prints out required information in monochrome in A4 and A3 paper.

8.4 Human Machine Interface

- The server shall be capable of management by the remote control from an operation PC.
- The operation PC shall have the following performance.
  - Number of CPU Core: Greater or equal 2 core
  - Memory: Greater or equal 2 Gigabyte
  - Hard Disk Drive: Greater or equal 250 Gigabyte
  - Power Consumption: less than 100W
  - System Inlet Temperature: 10 – 35 °C
  - Relative Humidity: 10 – 90%
  - Type: Space Saving
- The operation PC 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 server shall have equipment such as keyboard, joystick, and trackball so that the operator can input necessary commands into the system.
- The server shall be capable of management by remote control.

8.5 Communication Interface

- The server shall have the network adapter such as the Ethernet adapter.
- The server 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

- The 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 server shall be installed in air conditioned room in the 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

9. Ambient Conditions

- It is recommended that lighting condition of 200 lx is provided to allow easy operation and maintenance in the Regional 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. However, if it is defined for each equipment on requirement specification then shall be in accordance with the conditions.

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

10. Power Supply

- The nominal characteristics of the main supply are 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.

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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN 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 Regional Main Center 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)
- ITU-T X.200, ISO/IEC 7498-1: Information Technology – Open Systems Interconnection – Basic Reference Model: The Basic Model (OSI Reference Model)
- IETF RFC 791: Internet Protocol (IP)
- IETF RFC 793: Transmission Control Protocol (TCP)
- IETF RFC 894: A Standard for the Transmission of IP Datagrams over Ethernet Networks (IP over Ethernet)
- IEC 60529: Degrees of Protection provided by Enclosure (IP Code)
- BS 7430: Earthing
- BS 6651: Lightning Protection

2) National Standards

- TCVN 4054: 2005 Highway – Specifications for Design (3rd edition)
- TCVN 5729: 20112 Expressway – Specifications for Design
- TCVN 8078: 2009 Internet Protocol Gateway (IP Gateway) – Technical Requirements

- TCVN 9385:2012 Protection of structures against lightning – Guide for design, inspection and maintenance

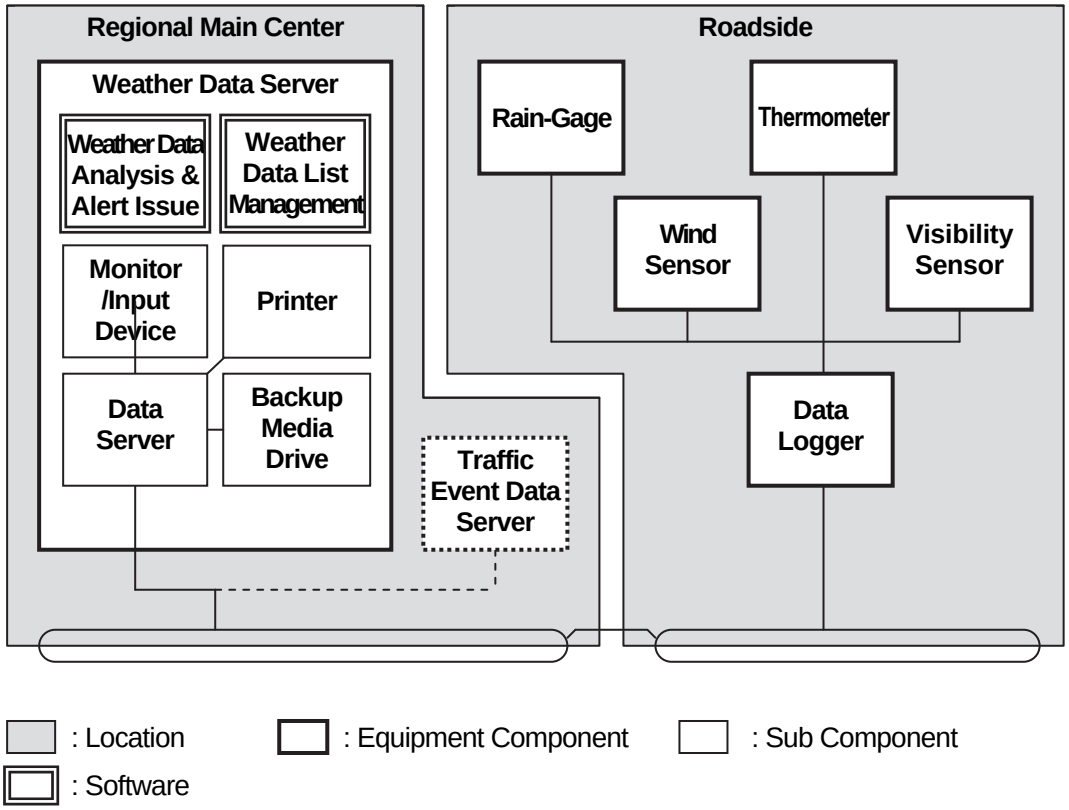
4. Requirements

- System shall be capable of measuring rainfall, wind speed, visibility, and air temperature.
- System shall be capable of automatically 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 inputting initial setting data of the bad weather classification threshold value.
- System shall be capable of detecting bad weather from the measurement result of the weather sensor.
- 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.
- The MOT shall be capable of instructing the manager of the system and of disclosing the specifications of the existing system in case there is an associated existing system.

5. System Architecture

System architecture for weather monitoring is shown below.

Figure 5.1 System Architecture for Weather Monitoring



Broken Lines: Outside of This Functional Package

6 Rain Gauge

6.1 Functions

- Rain gauge shall be capable to observe precipitation with the performance specified in item 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.

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6.2 Structure

- The rain gauge to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The rain gauge shall be tipping bucket type.
- The rain gauge shall have necessary reliability to fulfil the specified MTBF in the following clause.
- 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, and salt water.
- 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 activities.
- 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.
- This equipment component's min. should be 5 years effectiveness after calibration.

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 at least 10m away from the tree and building.
- The ground surface around the rain gauge shall be turfed or equivalent so as to avoid the backlash from the ground.
- 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 earthing of lightning protection system and other earthing facilities installed within a short distance.
- The site where the equipment component is installed shall be protected so that the general public cannot 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 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 wind sensor to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The wind sensor shall have necessary reliability to fulfil the specified MTBF in the following clause.
- 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.
- 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 activities.
- 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%
  d) Type : Except for the ultra-sonic type

- Accuracy of censor shall be verified before delivery.
- This equipment component's min. should be 5 years effectiveness after calibration.

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 wind sensor shall be installed min. 10 times of the distance of the nearest building 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 earthing of lightning protection system and other earthing facilities installed within a short distance.
- The site where the equipment component is installed shall be protected so that the general public cannot 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 8.3.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

8.2 Structure

- The visibility sensor to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The visibility sensor shall have necessary reliability to fulfil the specified MTBF in the following clause.
- 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.
- 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 activities.
- 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.
- This equipment component's min. should be 5 years effectiveness after calibration.

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

[1] MOR: Meteorological Optical Range

transmission between visibility sensor and data logger which collects observed visibility data at site where weather sensor is installed.

- Visibility sensor shall have the function to output test sensor to personal computers at site so that installation staff may adjust the direction of 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 visibility 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 earthing of lightning protection system and other earthing facilities installed within a short distance.
- The site where the equipment component is installed shall be protected so that the general public cannot 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 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 thermometer to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The housing and supporting structure of thermometer and housing shall be the structure to minimize affection of heat such as radiation, reflection and others except for the air temperature.
- The thermometer shall have necessary reliability to fulfil the specified MTBF in the following clause.
- 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.
- 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 activities.
- 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.
- This equipment component's min. should be 5 years effectiveness after calibration.

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 of output test connecting to personal computer 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 sensor is 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 thermometer 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 earthing of lightning protection system and other earthing facilities installed within a short distance.
- The site where the equipment component is installed shall be protected so that the general public cannot 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.
- The 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 the Regional Main Center.
- If weather sensor equips 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 network management system (NMS) to be installed at the Road Management Office shall be capable of detecting failure or fault of the data logger.
- 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.
- As for the failure of data logger, it shall be detected by network management system.

10.2 Structure

- The data logger to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The data logger shall have necessary reliability to fulfil the specified MTBF in the following clause.
- 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 to perform necessary functions stipulated in item 10.1.
- The data logger shall be capable to store the above calculation result for two (2) hours at least.
- The data logger shall be synchronized with Weather Data Server and the sensor which equips its own clock.
- This equipment component's min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

10.4 Human Machine Interfaces

- The data logger shall equip 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.
- In future after completion of the project, if the server is required to connect to the installed data logger, necessary information shall be disclosed to the related parties.

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 earthing of lightning protection system and other earthing facilities installed within a short distance.
- The site where the equipment component is installed shall be protected so that the general public cannot access to the equipment component easily.

11 Weather Data Server

11.1 Functions

- The server to be located in the Regional 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 server shall be capable to display on server data such as each site and as each observation element.
- The server shall be capable to display each observed element data at each site on the topographic map.

11.2 Structure

- The server to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The server shall be protected with measures against lightning.
- The chassis of server shall not be opened easily, and its door shall have a lock.

- The chassis of server shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The server shall be protected with measures against interference from other electronic devices
- The server shall have necessary reliability to fulfil the specified MTBF in the following clause.
- The server shall have the structure which is possible to fix in the building in the Regional Main Center.
- The structure of server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the server shall be capable to implement the periodical checking and clean-up activities.

11.3 Performance

- The server shall have the following performance.
    - Number of CPU Core: Greater or equal 4 cores
    - Memory：Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 300 Gigabyte
    - Corresponding to the Hot Plug function
    - Power Consumption: less than 800W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: rack mount
- The server (Blade Server) shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).
- The 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 server shall be synchronized with all data loggers
- The server shall have storage capacity to store at least five (5) years data on traffic volume, average speed, and congestion condition.
- The 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 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 back up 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 Weather Data Server.

- The server shall be capable of executing the restoration of backup data.
- Printer prints out required information in monochrome in A4 or A3 paper.
- This equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

11.4 Human Machine Interfaces

- The server shall be capable of management by the remote control from an operation PC.
- The operation PC shall have the following performance.
  - Number of CPU Core: Greater or equal 2 core
  - Memory: Greater or equal 2 Gigabyte
  - Hard Disk Drive: Greater or equal 250 Gigabyte
  - Power Consumption: less than 100W
  - System Inlet Temperature: 10 – 35 °C
  - Relative Humidity: 10 – 90%
  - Type: Space Saving
- The weather data server shall equip necessary human machine interface such as monitor screen, keyboard, and mouse.

11.5 Communication Interfaces

- The server shall be capable of transmitting all data and signals over TCP/IP.
- The Weather Data Server shall equip necessary interface such as Ethernet interface to connect to the network of the Regional 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. This condition is to be applied for future project when it is required.

11.6 Installation

- The server shall be capable of installing on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The server shall have database system such as Oracle or MySQL or etc.
- The server shall be installed in air conditioned room in the Regional Main Center.
- 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 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 earthing of lightning protection system and other earthing 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 Weather Data Server (Weather Data Analysis & Alert Issue)

12.1 Functions

- The system 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 Weather Data Server.
- The system shall be capable to change the threshold value to sound the buzzer from input devices.
- The system shall be capable to monitor the operating conditions of the weather sensors and data logger, and it shall be capable to identify whether failure is detected in each sensor or not.

12.2 Performance

- The thresholds om warnings shall be as follows;

  (i) Heavy rain (accumulated precipitation)

  Speed restriction should be disseminated 200mm or more, and closure should be made 250mm or more.

  (ii) Heavy rain (hourly rainfall)

  Warning should be disseminated when hourly rainfall reached 10mm or more, speed restriction should be informed when hourly rainfall reached 20mm or more, and closure should be made when hourly rainfall reached 40mm or more within one hour after reaching 100mm accumulated rainfall.

  (iii) High wind

  Warning should be disseminated when 10 minutes average wind speed reached 10 m/s, speed restriction should be disseminated when 10 minutes average wind speed reached 15 m/s or more, and closure should be made when 10 minutes average wind speed reached 25m/s.

  (iv) Dense fog

  Warning should be disseminated when visibility became 500 m or less, speed restriction should be disseminated when visibility became 200 m or less and closure should be made when the visibility became 50m or less.

(v) High temperature

The warning should be disseminated when the temperature became 40 degree of centigrade or more.

- The above thresholds shall be capable of modifying by the operator.

12.3 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 screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

12.4 Communication Interfaces

- The system shall be capable of transmitting 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.

12.5 Installation

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

13 Weather Data Server (Weather Data List Management)

13.1 Functions

- The system shall be capable of collecting observed data from each site and capable to update displayed data in every 5 minutes.
- The system shall be capable to compile collected observed data into database.
- The system shall be capable of searching compiled data, and searched result shall be capable to display on the screen.
- The system shall be capable of recording the compiled data to the external storage device.

13.2 Performance

- The software shall be capable of storing the 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 above data shall include the following items;

  - Each 5 minutes precipitation and accumulation of precipitation from commencement of rainfall up to completion.
  - Average and maximum wind speed. (The maximum wind speed shall be obtained from maximum average wind speed data of 3 seconds with sampling basis of 0.25 seconds)
  - Average and minimum visibility
  - The highest, the lowest and average temperature

- 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 saving the compiled data in CSV format. It shall be capable of being accessed and modified using commercially application software (such as Microsoft Excel).
- Language on system software shall be capable of being displayed in Vietnamese and English except for the geographic name.

13.3 Human Machine Interfaces

- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.
- 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 precipitation 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

13.4 Communication Interfaces

- The system shall be capable of transmitting 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.

13.5 Installation

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

14. 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.
- The equipment components shall be capable of operating under the following ambient

conditions;

For inside of the building

Temperature: 25 +/- 3 degree Celsuis in average

Relative humidity: between 20 and 80% in average

For outside

Temperature: between 0 and 50 degree Celsius

Relative humidity: maximum 95% in average

- It is recommended that the lighting condition of 200 lux is provided to allow easy operation and maintenance in the Regional Main Center.

15. Power supply

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

16. 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 DRVN, 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 DRVN, and the manufacturer/supplier shall provide the necessary services based on the contract.

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

18. 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

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

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

(9) Prior to handover, the DRVN, PMU3, responsible organization of O&M of the equipment components, the consultant and the related party will inspect all equipment components at roadside, the Regional Main Center and the Road Management Offices in order to verify the quantity of the equipment components with the contract conditions. The Contractor shall show each equipment component at site and shall bear the necessary cost of this inspection.

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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

The following conditions shall be as per the related clauses of the contract conditions;

(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 DRVN and the consultant

(4) The necessary number of submission of 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 Regional Main Center and the 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

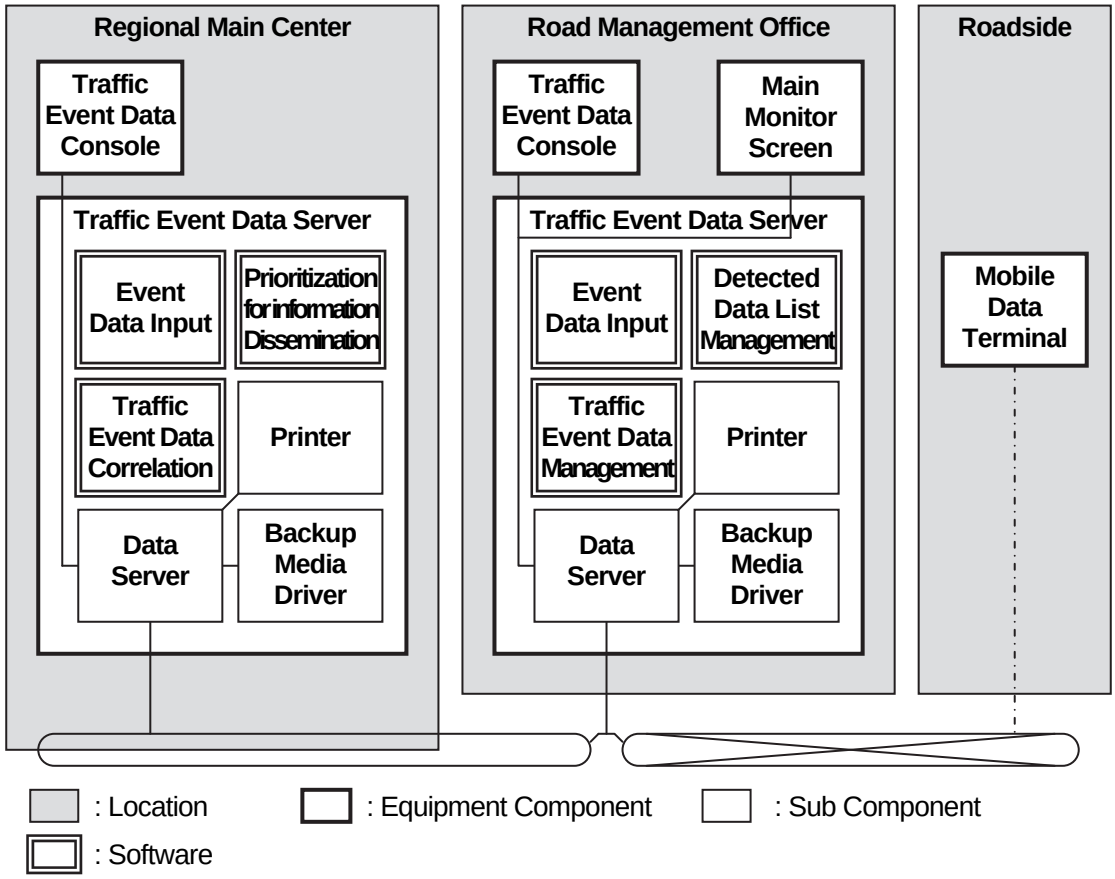
- System shall be capable of generating information in the form of traffic event from the results of CCTV monitoring, event detection, traffic analysis, and weather monitoring.
- System shall be capable of generating the traffic event including traffic accidents, reverse driving, broken-down vehicle, 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 causal traffic event.
- System shall be capable of setting priorities on generated/correlated traffic events by their place/seriousness.
- 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 1 minute in a database.
- System shall be capable of showing and printout (and also output as electronic data) about the needed results.
- System shall be capable of functioning in 24/7 by a redundant system and without the maintenance or replacement period of time.
- The MOT shall be capable of instructing the manager of the system and of disclosing the specifications of the existing system in case there is an associated existing system.

5. System Architecture

System architecture for traffic event data management is shown below.

Figure 5.1 System Architecture for Traffic Event Management



Broken Lines: Outside of This Functional Package

6. Traffic Event Data Server

6.1 Functions

- The server shall be capable of displaying and printing out the traffic event data related data obtained by Event Detection, Traffic Analysis, and Weather Sensors.
- The server shall be capable of storing all traffic event data.
- The server shall be capable of making backup of the stored data.
- The server shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period and power outage period.

6.2 Structure

- The server shall be protected with measures against lightning.
- The chassis of server shall not be opened easily, and its door shall have a lock.
- The chassis of server shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The server shall be protected with measures against interference from other electronic devices.
- The server shall have the structure which is possible to fix in the building in the Regional Main Center and the Road Management Offices.
- The structure of server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the server shall be capable to implement the periodical checking and clean-up activities.

6.3 Performance

- The server shall have the following performance;
    - Number of CPU Core: Greater or equal 4 cores
    - Memory：Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 300 Gigabyte
    - Corresponding to the Hot Plug function
    - Power Consumption: less than 800W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: rack mount

- The server (Blade Server) shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).
- The server shall be capable of transmitting the traffic event data to Traffic Event Data Server at the Road Management Office.
- The server shall be capable of transmitting the statistical data to Traffic Event Data Server at the Road Management Office.
- The server shall be capable of storing traffic event data.
- The server shall be capable of retrieving and displaying the transaction records which are stored Traffic Event Data by using retrieve condition elements which are input by using “Data Input Device”.
- The server shall have storage capacity to store all data on Traffic Event Data.
- The server shall be capable of executing backup of the stored data in the server on the date which is set up in advance. Incident Data Set, Traffic Congestion Data Set, Construction Data Set, Traffic Restriction Data Set, Traffic Event Data Set.
- 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 back up 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 server shall be capable of executing the restoration of backup data.

6.4 Human Machine Interface

- The server shall be capable of management by the remote control from an operation PC.

6.5 Communication Interface

- The server shall have the network adapter such as the Ethernet adapter.
- 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

- The server shall be capable of installing on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The 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 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 Event Data Server (Traffic Event Data Management)

7.1 Functions

- The system shall be capable of correlating and categorizing plural traffic event data with related data obtained by Event Detection, Traffic Analysis, and Weather Sensors.
- The system shall be capable of storing the transmitted traffic event data and message data from the Regional Main Center.

7.2 Performance

- The system shall be capable of automatically assigning serial number into Traffic Event Data Server in corresponding to the storing time of traffic event data which is obtained by

Event Detection, Traffic Analysis, and Weather Sensors.

- The system 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.
- The system shall be capable of releasing the relationship of the Correlated Traffic Event Data after completion, based on the input conditions from Traffic Supervision.
- The system shall be capable of correlating the Correlated Traffic Event Data with its attribution of serial number, place, time & date, event types, serial number.
- The system shall be capable of defining the place of event by road section and kilometre signpost.
- The system shall be capable of defining the time and date of the event by year, month, date, hour, minute.
- 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 automatically updating the traffic event data when an event occurs.
- The system 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).
- Language on system software shall be capable of being displayed in Vietnamese and English except for the geographic name.

7.3 Human Machine Interface

- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

7.4 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 disclosed in order to secure the interoperability of devices.

7.5 Installation

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

8. Traffic Event Data Server (Prioritization for Information Dissemination)

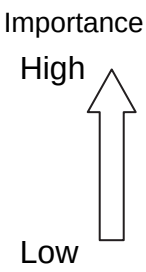
8.1 Functions

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

8.2 Performance

- The system shall be capable of prioritizing information on traffic events to be disseminated by the importance and the place of the event occurrence.
- The system 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 8.1 Importance of the Cause of the Event



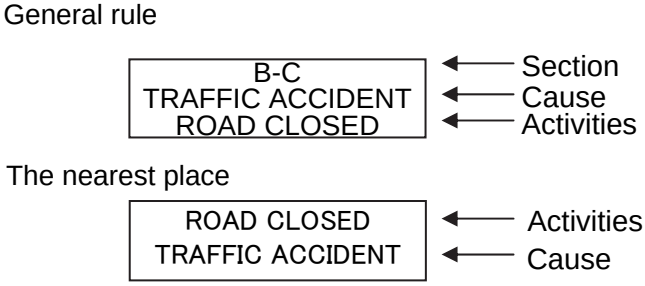
Cause of the Event
Vandalism
Traffic accident
Breakdown vehicle
Left obstruction
Natural disaster
Roadwork
Significant weather
Others

- The system 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.

- The system 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.
- 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.

8.3 Human Machine Interface

- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

8.4 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 disclosed in order to secure the interoperability of devices.

8.5 Installation

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

9. Traffic Event Data Server (Event Data Input)

9.1 Functions

- The system shall be capable of inputting plural traffic event data.
- The system shall be capable of registering and deleting and editing plural traffic event data.

9.2 Performance

- 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 Traffic Event Data Console.

9.3 Human Machine Interface

- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

9.4 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 disclosed in order to secure the interoperability of devices.

9.5 Installation

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

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

10.1 Functions

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

- The system shall be capable of storing the transmitted traffic event data and message data from the Road Management Offices and shall be capable of displaying it on the monitor screen.
- The system shall be capable of receiving the related information of traffic congestions from traffic analysis processor.

10.2 Performance

- The system shall be capable of storing the transmitted traffic event data and message data from Traffic Event Data Server at the Road Management Offices and shall be capable of compiling it in a database.
- The system shall be capable of compiling statistical data and making reports: daily report, weekly report, monthly report, and yearly report.
- 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 automatically updating the traffic event data when an event occurs.
- The system 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).
- Language on system software shall be capable of being displayed in Vietnamese and English except for the geographic name.

10.3 Human Machine Interface

- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

10.4 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 disclosed in order to secure the interoperability of devices.

10.5 Installation

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

11. Traffic Event Data Server (Detected Data List Management)

11.1 Functions

- The system shall be capable of receiving, compiling and manage the Traffic Event Data.
- The system shall be capable of correlating and categorizing plural traffic event data with related data obtained by Event Detection, Traffic Analysis, and Weather Sensors.

11.2 Performance

- 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.
- The system shall be capable of compiling statistical data and making reports: daily report, weekly report, monthly report, and yearly report.
- 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 automatically updating the traffic event data when an event occurs.
- The system 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).
- Language on system software shall be capable of being displayed in Vietnamese and English except for the geographic name.

11.3 Human Machine Interface

- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

11.4 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 disclosed in order to secure the interoperability of devices.

11.5 Installation

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

12. Traffic Event Data Console

12.1 Functions

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

12.2 Structure

- The console shall be protected with measures against lightning.
- The console shall be protected with measures against interference from other electronic devices.
- The console shall have the structure which is possible to fix in the building in the Regional Main Center.
- The structure of console shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the console shall be capable to implement the periodical checking and clean-up activities.

12.3 Performance

- Recommended size of the monitor screen shall be 20 inches or more to check the stored traffic event data and message data in Traffic Event Data Server on the monitor.

- Recommended resolution of the monitor screen shall be 1920x1080 dpi or more.
- The operation PC shall have the following performance.
    - Number of CPU Core: Greater or equal 2 core
    - Memory: Greater or equal 2 Gigabyte
    - Hard Disk Drive: Greater or equal 250 Gigabyte
    - Power Consumption: less than 100W
    - System Inlet Temperature: 10 – 35 °C
    - Relative Humidity: 10 – 90%
    - Type: Space Saving
- The console shall be capable of displaying the retrieved results on the monitor screen.
- The console shall be capable of printing information which is displayed on Monitor Screen.
- All screens shall have user-friendly interface.
- The console shall be capable of printing retrieved results by A4/A3 type printer.

12.4 Human Machine Interface

- The console shall have human machine interface for “Operator” to input searching conditions to retrieve the Traffic Event Data.
- The console shall have equipment such as keyboard and optical mouse.
- The console shall have two or more display terminals.

12.5 Communication Interface

- The server shall have the network adapter such as the Ethernet adapter.
- The console 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.

12.6 Installation

- The server shall be capable of installing 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 Traffic Event Data Monitor shall be installed in air conditioned room in the 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.

13. Main Monitor Screen

13.1 Functions

- The Main Monitor Screen shall be capable of displaying the traffic event data on the integrated display with its related attributes.
- The Main Monitor Screen shall be capable of displaying the required menu on the combined screen.
- The Main Monitor Screen shall be capable of returning to the original displaying conditions after traffic event is cleared.
- The Main Monitor Screen shall be capable of operating continuously 24hours a day for 365 days a year, except for maintenance and repair period and power outage period.

13.2 Structure

- The screen shall be protected with measures against lightning.
- The chassis of screen shall not be opened easily.
- The chassis of screen shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The screen shall be protected with measures against interference from other electronic devices.
- The structure of screen shall be capable to replace the faulty parts simply and easily when it is detected.

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

13.3 Performance

- The screen shall be capable of combining several displays into one large screen display to make 100 inches or more. The unit display size shall be 50 inches or more.
- The borders between neighbouring 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 equipment which is distributed from supplier.
- The screen shall be capable of switching to show images in rotation.
- The screen shall be capable of showing a locked image that is selected by the Operator.

13.4 Human Machine Interface

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

13.5 Communication Interface

- 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.

13.6 Installation

- The equipment of components shall be installed at each Road Management Offices.
- 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 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 lighting protection system and other grounding facilities installed within short distance.

14. Mobile Data Terminal

14.1 Functions

- The terminal shall be capable of inputting and storing the information for patrol crew on the site.
- The terminal shall be capable of transmitting with the data in real time by the server of the Road Management Office.

14.2 Structure

- The terminal shall be protected with measures against water, rust, dust, salt water.
- The terminal shall be protected with measures against interference from other electronic devices.
- The terminal shall have the durability for the fall and the vibration.

14.3 Performance

- The liquid crystal display panel shall be capable of getting visibility under outdoor light of the sun by an anti-reflection sheet.
- The liquid crystal display panel shall have the low brightness mode which it can control in the night and the darkness, and it shall be capable of taking the night photo.
- The terminal shall have the encryption function for data communication.
- The liquid crystal display panel size shall be 7 inches or more.

- The terminal shall have the sensor such as acceleration, Gyro, Geomagnetism, Illumination and GPS.

14.4 Human Machine Interface

- The display shall have the capacitance touch panel.

14.5 Communication Interface

- The terminal shall have the high-speed communication such as Wi-Fi and Bluetooth
- The terminal shall have the input terminals, such as RS-232C D-sub 9-pin, USB Ethernet conversion driver and LAN port.

15. 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 components shall be capable of operating normally under the following ambient conditions: However, if it is defined for each equipments on requirement specification then shall be in accordance with the conditions.

  For Regional Main Center, Road Management Office, Toll Management Center, and Toll Office

  Temperature: 25 +/- 3 degree Celsius in average

  Relative humidity: between 20 and 80 % in average

  For outside

  Temperature: between - 0 and +50 degree Celsius

  Relative humidity: below 95 %
- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Regional Main Center and the Road Management Office.

16. Power Supply

- The nominal characteristics of the main supply are 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.

17. Maintainability

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

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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of

authorized staff of DRVN and/or the consultant.

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN and the consultant

(4) The necessary number of submission documents

(8)
Traffic Supervision

1. General Outline

This functional package allows the road operators at the Regional Main Center and the 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 Regional Main Center and the Road Management Office 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

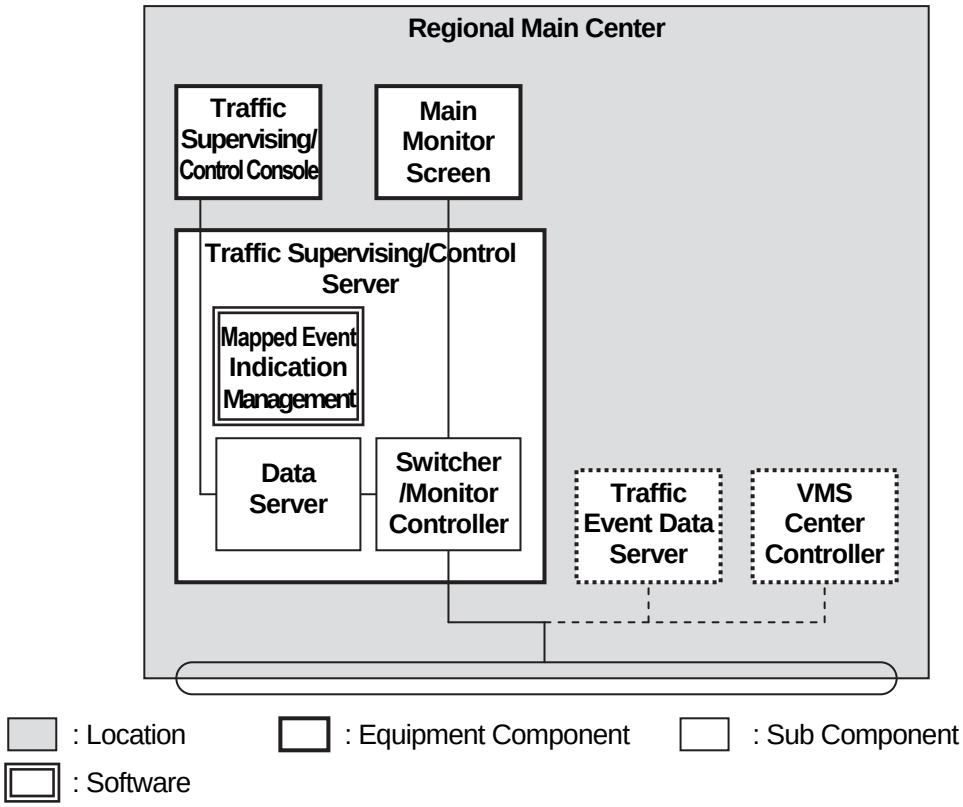
4. Requirements

- System shall be capable of allowing inputting the necessary data 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 traffic 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 Regional Main Center and the Road Management Office.
- System shall be capable of functioning in 24/7 by a redundant system and without the maintenance or replacement period of time.
- The MOT shall be capable of instructing the manager of the system and of disclosing the specifications of the existing system in case there is an associated existing system.

5. System Architecture

System architecture for traffic supervision is shown below.

Figure 5.1 System Architecture for Traffic Supervision



6. Traffic Supervising/Control Server

6.1 Functions

- The server shall be capable of displaying 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 and CSS also shall be displayed on the expressways corresponding to their location on the combined screen, with function of displaying the disseminating information.
- The server shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period and power outage period.

6.2 Structure

- The server shall be protected with measures against lightning, rust, and dust.
- The chassis of server shall not be opened easily, and its door shall have a lock.
- The chassis of server shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The server shall be protected with measures against interference from other electronic devices.
- The server shall have the structure which is possible to fix in the building in the Regional Main Center.
- The structure of server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the server shall be capable to implement the periodical checking and clean-up activities.

6.3 Performance

- The server shall have the following performance;
    - Number of CPU Core: Greater or equal 4 cores
    - Memory：Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 300 Gigabyte
    - Corresponding to the Hot Plug function
    - Power Consumption: less than 800W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: rack mount

- The server (Blade Server) shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).
- The server shall have storage capacity to store all data on traffic event data.
- The 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 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 back up 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 server shall be capable of executing the restoration of backup data.
- This equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

6.4 Human Machine Interface

- The server shall be capable of management by the remote control from an operation PC.

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 server shall be capable of installing 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 server shall be installed in air conditioned room in the 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 Supervising/Control Server (Mapped Event Indication Management)

7.1 Functions

- The system 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.
- The system 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.
- The system 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.

7.2 Performance

- The system 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.

- The system 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.
- The system 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.
- The system 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.
- The system 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 system shall be capable of control all of display units like one display.
- The system shall be capable of display all of traffic management information such as CCTV images, traffic information, weather information, VMS information, and so on.

7.3 Human Machine Interface

- The screen shall have user friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

7.4 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 disclosed in order to secure the interoperability of devices.

7.5 Installation

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

8. Traffic Supervising/Control Console

8.1 Functions

- The console shall be capable of displaying the traffic event data on the integrated display with its related attributes.
- The console 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 console 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 and CSS.
- The console shall be capable of returning to the original displaying conditions after traffic event is cleared.

8.2 Structure

- The console shall be protected with measures against lightning.
- The console shall be protected with measures against interference from other electronic devices.
- The console shall have the structure which is possible to fix in the building in the Regional Main Center.
- The structure of console shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the console shall be capable to implement the periodical checking and clean-up activities.

8.3 Performance

- Recommended size of the monitor screen shall be 20 inches or more to check the stored traffic event data and message data in Traffic Event Data Server on the monitor.
- Recommended resolution of the monitor screen shall be 1920x1080 dpi or more.
- The operation PC shall have the following performance.
    - Number of CPU Core: Greater or equal 2 core
    - Memory: Greater or equal 2 Gigabyte
    - Hard Disk Drive: Greater or equal 250 Gigabyte
    - Power Consumption: less than 100W
    - System Inlet Temperature: 10 – 35 °C

- Relative Humidity: 10 – 90%
- Type: Space Saving

- The console shall be capable of displaying the retrieved results on the monitor screen.
- The console shall be capable of printing information which is displayed on Monitor Screen.
- All screens shall have user-friendly interface.
- The console shall be capable of printing retrieved results by A4/A3 type printer.
- This equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

8.4 Human Machine Interface

- The console shall have human machine interface to display each message's position and time on the screen.
- The console shall have equipment such as keyboard and optical mouse.
- The console shall have two or more display terminals.

8.5 Communication Interface

- The console shall have the network adapter such as the Ethernet adapter.
- The console 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.

8.6 Installation

- The operation PC shall be capable of installing on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The operation PC shall be installed at the Regional Main Center.
- 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 Traffic Supervising/Control Console shall be installed in air conditioned room in the 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. Main Monitor Screen

9.1 Functions

- The Main Monitor Screen shall be capable of displaying the traffic event data on the integrated display with its related attributes.
- The Main Monitor Screen 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 Main Monitor Screen 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 and CSS.
- The Main Monitor Screen shall be capable of returning to the original displaying conditions after traffic event is cleared.
- The Main Monitor Screen shall be capable of operating continuously 24hours a day for 365 days a year, except for maintenance and repair period and power outage period.

9.2 Structure

- The screen shall be protected with measures against lightning.
- The chassis of screen shall not be opened easily.
- The chassis of screen shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The screen shall be protected with measures against interference from other electronic devices.
- The structure of screen shall be capable to replace the faulty parts simply and easily when it is detected.

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

9.3 Performance

- The Main Monitor Screen shall be capable of combining several displays into one large screen display to make 300 inches or more. The unit display size shall be 60 inches or more.
- The borders between neighbouring 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 equipment which is distributed from supplier.
- The screen shall be capable of combining several displays into one large screen display. The unit display size shall be 60 inches or more.

Figure 9.1 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 Operator.
- This equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

9.4 Human Machine Interface

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

9.5 Communication Interface

- 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.

9.6 Installation

- The equipment of components shall be installed at the Regional Main Center.
- 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

10. Ambient Conditions

- The equipment component shall be installed in the office and protected from interferences of other electronic devices.
- The equipment components shall be capable of operating normally under the following ambient conditions: However, if it is defined for each equipments on requirement specification then shall be in accordance with the conditions.

  For Regional Main Center, Road Management Office, Toll Management Center, and Toll Office

  Temperature: 25 +/- 3 degree Celsius in average

Relative humidity: between 20 and 80 % in average

For outside

Temperature: between - 0 and +50 degree Celsius

Relative humidity: below 95 %

- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Regional Main Center.

11. Power Supply

- The nominal characteristics of the main supply are 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.

12. Maintainability

- The equipment components shall be capable of being maintained 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN and the consultant

(4) The necessary number of submission documents

(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 Regional Main Center 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 4054:2005 , Motorway - Requirements KEH
- TCVN 5729
- TCVN 2737:1995

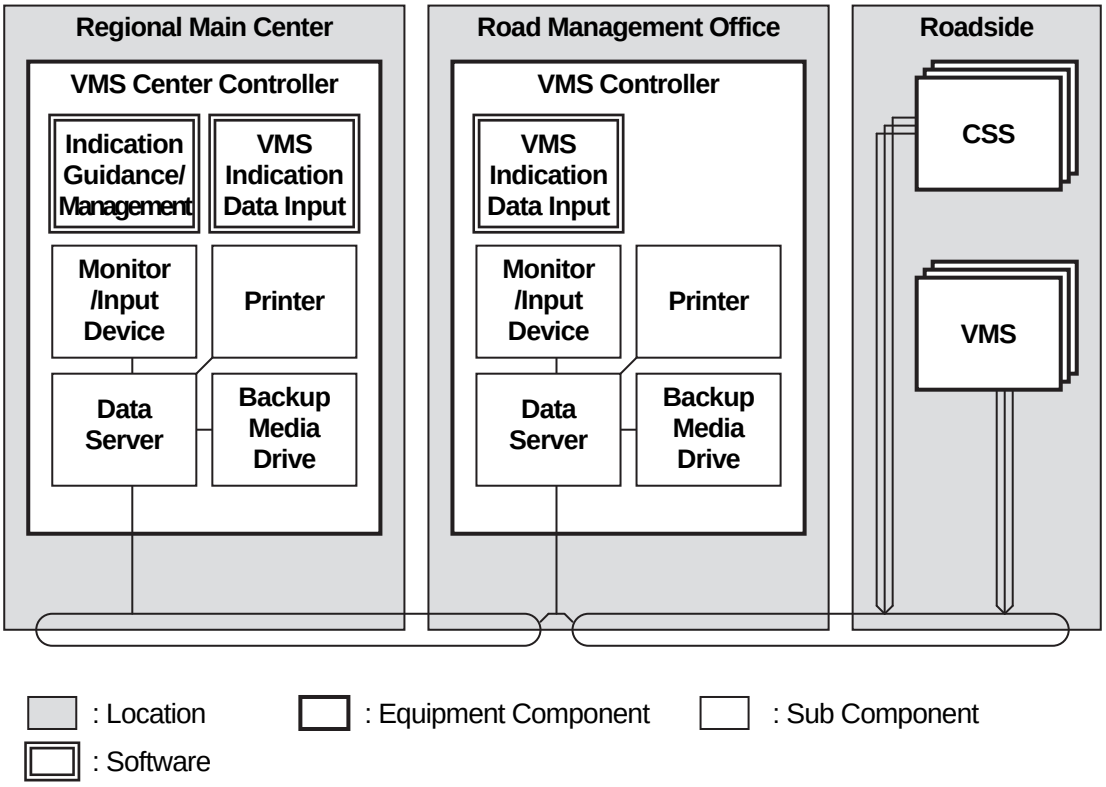
4. Requirements

- System shall be capable of disseminating information in the form of traffic events by using VMSs located in front of entrance gates, exit gates, junctions and other places; the traffic events shall include traffic accidents, reverse driving, breakdown vehicles, left obstacle, natural disaster, vandalism, construction work, bad weather, flood, fire, traffic congestion, and traffic restriction.
- System shall be capable of sending guidance of the information to be indicated on the VMSs on Adjoining section to the competent Road management Office from the Regional Main Center and of controlling the VMSs directly from the Regional Main Center in case of serious incidents.
- System shall be capable of indicating information in Vietnamese and English.
- System shall be capable of indicating textual information to the drivers to read in their vehicles at the maximum speed 120 km/h.
- System shall be capable of indicating, output the needed data (soft copy), and printing out the needed results.
- System shall be capable of allowing installing roadside equipment in front of entrances, exits, junctions, and tunnels on the expressways.
- System shall be capable of functioning in 24/7 by a redundant system without the maintenance or replacement period of time.
- System shall be capable of indicating the image such as pictographs in full-color.
- System shall be capable of disseminating the textual information which is directly input from the Regional Main Center and the Road Management Office, irrespective of traffic event.
- System shall be capable of being switched back and forth the different information automatically by controlling from the Regional Main Center and the Road Management Office.
- System shall be capable of minimizing load caused by data transmission, including video image on the communication system.
- The MOT shall be capable of instructing the manager of the system and of disclosing the specifications of the existing system in case there is an associated existing system.

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 robust structure, shape, size, and lightweight.
- 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 side and 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.

6.3 Performance

- The height of displayed letters shall be 400 mm more.
- The width of displayed letter shall be 16-86% of letter height (i.e., 64-342 mm). It is accordance to 22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC (Message/Signs for Highways) in appendix 2 QUY ĐỊNH VỀ CHỮ VIẾT VÀ CON SỐ SỬ DỤNG TRONG CÁC BIỂN BÁO HIỆU TRÊN ĐƯỜNG CAO TỐC.
- One displayed row shall not have more than 27 letters.

- LED shall be used for displaying panel, concerning its durability and light intensity.
- The equipment components shall be capable of displaying in Vietnamese (with circumflex) 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) in appendix 2 QUY ĐỊNH VỀ CHỮ VIẾT VÀ CON SỐ SỬ DỤNG TRONG CÁC BIỂN BÁO HIỆU TRÊN ĐƯỜNG CAO TỐC.
- The equipment components shall be capable of controlling displayed information 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.
- The equipment components shall be equipped with the function which is against for burn-in of LED panel.
- Dot intervals of LED elements shall be less than 16 mm.
- The brightness of each display colour in day and night time as Table below, the brightness shall automatically adjust considering the environment and not become dim under strong light and not become too bright at night

Table 6.1 The Brightness of Displayed Color of VMS

Displayed Color	Brightness at day time	Brightness at night time
Blue	2700cd/㎡ or more	145cd/㎡ or more
Red	1600cd/㎡ or more	85cd/㎡ or more
Green	2200cd/㎡ or more	120cd/㎡ or more
White	4300cd/㎡ or more	230cd/㎡ or more
Yellow	3800cd/㎡ or more	205cd/㎡ or more
Cyan	2700cd/㎡ or more	145cd/㎡ or more
Orange	2500cd/㎡ or more	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 changed 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 VMS

Center Controller.

- Base colour of the displaying panel shall be mat black.
- There are three types of VMS, Type-A, Type-B, Type-C. These types of VMS are chosen 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 Junction

Specification:

- Display type: full-colour LED
- Number of rows: 3 rows
- Number of columns: 27 columns/row
- Letter Height: 400mm
- LED module Colour: Red, Blue, Light green
- LED dot pitch: 16mm or less
- Resolution: 89(height) x 623(width) dots (55,477 dots or more)
- Weight: 1,200kg or less

Type-B:

Location: In front of entrance and exit

Specification:

- Display type: full-colour LED
- Number of rows: 2 rows
- Number of columns: 27 columns/row
- Letter Height: 4000mm
- LED module Colour: Red, Blue, Light green
- LED dot pitch: 16mm or less
- Resolution: 59(height) x 623(width) dots (36,757 dots or more)
- Weight: 800kg or less

Type-C:

Location: In front of entrance, in case of there is NOT enough space for the installation of VMS on access road.

Specification:

- Display type: full-colour LED

- Number of rows: 3 rows
- Number of columns: 14 columns/row
- Letter Height: 400mm
- LED module Colour: Red, Blue, Light green
- LED dot pitch: 16mm or less
- Resolution: 89(height) x 363(width) dots (32,307 dots or more)
- Weight: 700kg or less

- The equipment component's min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

6.4 Human Machine Interface

- VMS shall indicate information in Vietnamese letter with height of 400 mm more.
- VMS shall have the function to indicate the information with 27 Vietnamese syllables 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 27 Vietnamese syllables 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 27 Vietnamese syllables 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 the Regional Main Center and the Road Management Office, irrespective of Traffic Event Data.
- The VMS which is input 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 communication interface 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 on gantry, roadside pole or other similar structures.
- VMS shall be installed so that they may not obstruct the vertical clearance according to TCVN 4054 and TCVN 5729.
- VMS shall be protected from outside at minimum level of IP65.
- VMS shall be installed on the stable structures that sufficient structure in case of typhoon Level 12.
- 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 should be located at approximately 200m before the entrance of Junction to the extent possible.
- VMS Type-B should be located at approximately 200m before the entrance of expressway and exit of expressways to the extent possible.
- The location of VMS shall be consideration based on site survey by the contractor and shall be getting the approval from the supervisor.
- VMS Type-C is chosen according to the site conditions, such as the construction of gantry is difficult and cost of construction.
- In case the equipment 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.

7. CSS (Changeable Speed Limit Sign)

7.1 Functions

- The equipment components shall be capable of display the speed limit sign accordance with the regulation the speed limit of each lane considering the weather condition, on-going traffic event.
- The equipment components 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.
- 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 robust structure, shape, size, and lightweight.
- 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 its side and 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.
- Dimension of Speed Limit Sign on CSS shall follow Vietnamese Standards on 22TCN237-01 Regulation on Road Signs.
- Diameter of Speed Limit Sign on CSS shall be 122.5 cm, it is accordance with

22TCN237-01 Regulation on Road Signs.

7.3 Performance

- The height of displayed letters shall be 400 mm.
- The width of displayed letter shall be 25-72% of letter height (i.e., 98-286 mm). It is accordance with 22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC (Message/Signs for Highways) in appendix 2 QUY ĐỊNH VỀ CHỮ VIẾT VÀ CON SỐ SỬ DỤNG TRONG CÁC BIỂN BÁO HIỆU TRÊN ĐƯỜNG CAO TỐC.
- LED shall be used for display panel, considering its durability and light intensity.
- Dimension of Speed Limit Sign on CSS shall be referred according to Vietnamese Standards on 22TCN237-01 Regulation on Road Sign.
- The specification of CSS as follows,
  - Display type: full-colour LED
  - Shape of CSS: 1,225mm phi
  - Letter Height: 400mm
  - LED module Colour: Red, Blue, Light green
  - LED dot pitch: less than 16mm
  - Resolution: 4,600 dots more
  - Weight: less than 100kg
- 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 and night time as Table below, the brightness shall automatically adjust considering the environment and not become dim under strong light and not become too bright at night

Table 6.2 The Brightness of Displayed Color of CSS

Displayed Color	Brightness at day time	Brightness at night time
Blue	2700cd/㎡ or more	145cd/㎡ or more
Red	1600cd/㎡ or more	85cd/㎡ or more
Green	2200cd/㎡ or more	120cd/㎡ or more
White	4300cd/㎡ or more	230cd/㎡ or more
Yellow	3800cd/㎡ or more	205cd/㎡ or more

Cyan	2700cd/㎡ or more	145cd/㎡ or more
Orange	2500cd/㎡ or more	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's min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

7.4 Human Machine Interface

- CSS shall indicate information in letter height of 400 mm or more, and CSS shall have the function to indicate the speed limit so that the driver who drives a vehicle with 120 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 communication interface 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.

- CSS shall be installed at around merging point on through way and intervals of 5 km or less.
- CSS shall be protected from outside at minimum level of IP65.
- CSS shall be installed on the stable structures that sufficient structure in case of typhoon Level 12.
- 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 equipment 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.

8. VMS Center Controller

8.1 Functions

- The controller shall be capable of displaying and printing out the VMS and CSS indication data related data by event data.
- The controller shall be capable of storing all VMS and CSS indication data.
- The controller shall be capable of making backup of the stored data.
- The controller shall be capable of synchronizing its clock to the clock of "Traffic Supervising / Control Server" at the start-up.
- The controller shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period and power outage period.

8.2 Structure

- The equipment components shall have robust structure, shape, size, and lightweight.
- The controller shall be protected with measures against lightning.
- The chassis of controller shall not be opened easily, and its door shall have a lock.
- The controller shall be protected with the measures against interference from other

electronic devices

- The controller shall have the structure which is possible to fix in the building in the Regional Main Center and the Road Management Offices.
- The structure of controller shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the controller shall be capable to implement the periodical checking and clean-up activities.

8.3 Performance

- The server shall have the following performance.
    - Number of CPU Core: Greater or equal 4 cores
    - Memory：Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 300 Gigabyte
    - Corresponding to the Hot Plug function
    - Power Consumption: less than 800W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: rack mount
- The server (Blade Server) shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).
- The controller shall be capable of transmitting the VMS/CSS indication data to VMS Controller at the Road Management Offices.
- The controller shall be capable of receiving the VMS/CSS indication data from VMS Controller at the Road Management Offices.
- The controller shall be capable storing the VMS/CSS indication data.
- The controller 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.
- The controller shall be capable of executing backup of the stored data which is set up in advance.
- 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 back up 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 controller shall be capable of running a restoration of backup data.
- Printer prints out required information in monochrome in A4 or A3 paper.
- This equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

8.4 Human Machine Interface

- The controller shall have a human-machine interface for the Operator to input necessary commands.
- The server shall be equipped with display device and data input device.
- The system shall be capable of displaying generated letter string on monitor screen for confirmation.
- The controller shall have two or more display terminal.
- The controller shall have the function to directly input the displayed information from VMS Center Controller at the Regional Main Center and the Road Management Office, irrespective of Traffic Event Data.
- The controller shall be capable of management by the remote control from an operation PC.
- The operation PC shall have the following performance.
    - Number of CPU Core: Greater or equal 2 core
    - Memory: Greater or equal 2 Gigabyte
    - Hard Disk Drive: Greater or equal 250 Gigabyte
    - Power Consumption: less than 100W
    - System Inlet Temperature: 10 – 35 °C
    - Relative Humidity: 10 – 90%
    - Type: Space Saving
- The operation PC shall have human machine interface for "Operator" to input searching conditions to retrieve the "Transaction data" and "Toll collection data".
- The operation PC shall have equipment such as keyboard and optical mouse.

8.5 Communication Interface

- The controller shall have the network adapter such as the Ethernet adapter.
- The controller 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.

8.6 Installation

- The controller shall be capable of installing on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The controller shall have database system such as Oracle or MySQL or etc.
- 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.

9. VMS Center Controller (Indication Guidance/Management)

9.1 Functions

- The system shall be capable of acquiring the information currently displayed on VMS and CSS.
- The system shall be capable of monitoring the operation status such as pixel error, power error, transmission error, memory checking, sensor error, overheat warning from

VMS Centre Controller.

- The system shall be capable of assisting for operator 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 system 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 Traffic Event information, which is received from “Traffic Event Data Server”.
- The system shall be capable of generating a letter string to be displayed on VMS, based on the information which is inputted from “VMS Indication Data Input” of “VMS Data Controller” which is installed at the Regional Main Center.
- The system shall be capable of generating a letter string to be displayed on CSS, based on the Traffic Event 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 “VMS Indication Data Input” of “VMS Data Controller” which is installed at the Regional Main Center.

9.2 Performance

- The system shall be capable of sending a signal to control LED device of VMS/CSS 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/CSS at the present moment.
- The system shall be capable of displaying on Monitor screen the list of VMS/CSS and the data which is inputted in each VMS/CSS 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/CSS and storing “VMS Indication Data Set” which generate letter strings.
- The system shall be capable of sending a data to controller of LED device in order to display generated letter strings on VMS/CSS.
- The system shall be capable of displaying on Monitor Screen the letter string which is being displayed on each VMS/CSS at the moment.
- The system shall be capable of displaying on Monitor screen the list of VMS/CSS and the data which is input in each VMS/CSS at the 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/CSS and storing “VMS Indication Data Set” which generate letter strings.
- The system shall be capable of extracting letter strings displayed on VMS/CSS and “VMS Indication Data Set” generated from accumulated VMS database, based on searching conditions, which are inputted from “VMS Indication Data Input”, and then displaying the results on Monitor Screen.
- The system shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

9.3 Human Machine Interface

- The screen shall have user friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.
- 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.

9.4 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- Necessary communication interface 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.

9.5 Installation

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

10. VMS Center Controller (VMS Indication Data Input)

10.1 Functions

- The system shall be capable of generating a letter string to be displayed on VMS, based on the information which is inputted by using input devices such as keyboard and mouse.

- The system shall be capable of generating a letter string to be displayed on CSS, based on the following information which is inputted by using input devices such as keyboard and mouse.
- The system shall be capable of synchronizing its clock to the clock of “Traffic Supervising / Control Server” at the start-up.
- The system shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

10.2 Performance

- The system shall be capable of sending a data to controller of LED device in order to display generated letter strings on VMS/CSS.
- 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/CSS 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/CSS and “VMS Indication Data Set” generated from accumulated VMS database, based on searching conditions, which are inputted by using input device such as keyboard and mouse, and then displaying the results on Monitor Screen.
- The system shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

10.3 Human Machine Interface

- The screen shall have user friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.
- 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.

10.4 Communication Interface

- The system shall be capable of transmitting all data and signals over TCP/IP.
- The system 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 communication interface 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.

10.5 Installation

- In case that some parts of function required are realized by some pieces of system shall be capable of being installed on an operating system such as Microsoft Windows or Linux which is widely used in many countries.
- The system shall be installed in VMS Center Controller at the Regional Main Centre and the Road Management Office.

11. VMS Controller

11.1 Functions

- The controller shall be capable of acquiring the information currently displayed on VMS and CSS.
- The controller shall be capable of monitoring the operation status such as pixel error, power error, transmission error, memory checking, sensor error, overheat warning.
- The controller shall be capable of synchronizing its clock to the clock of “Traffic Supervising / Control Server” at the start-up.
- The controller shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.

11.2 Structure

- The controller shall have robust structure, shape, size, and lightweight.
- The chassis of controller shall not be opened easily, and its door shall have a lock.
- The controller shall be protected with measures against lightning.
- The controller shall be protected with the measures against interference from other electronic devices
- The controller shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period.
- The structure of controller shall be capable to replace the faulty parts simply and easily

when it is detected.

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

11.3 Performance

- The server shall have the following performance.
    - Number of CPU Core: Greater or equal 4 cores
    - Memory：Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 300 Gigabyte
    - Corresponding to the Hot Plug function
    - Power Consumption: less than 800W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: rack mount
- The controller (Blade Server) shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).
- The controller shall be capable of sending a signal to control LED device of VMS/CSS in order to display generated letter strings on VMS/CSS.
- The controller shall be capable of transmitting the VMS/CSS indication data to VMS Center Controller at the Regional Main Center.
- The controller shall be capable of receiving the VMS/CSS indication data from VMS Center Controller at the Regional Main Center.
- The controller shall be capable storing the VMS/CSS indication data.
- The controller shall have disk capacity for storing data for at least one year.
- The controller shall have “Backup Media Drive” for Backup of the stored data in the Data Server.
- The controller shall be capable of executing the backup of the stored data on a date which is set up in advance.
- 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 back up 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 VMS Controller.

- The controller shall be capable of running a restoration of backup data.
- This equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

11.4 Human Machine Interface

- The system shall have a human-machine interface for the Traffic Information Operator to input necessary commands.
- The system shall be equipped with display device and data input device.
- The system shall be capable of displaying generated letter string on monitor screen for confirmation.
- The system shall have the function to directly input the displayed information from VMS Controller at the Road Management Office, irrespective of Traffic Event Data.
- The operation PC shall have the following performance.
    - Number of CPU Core: Greater or equal 2 core
    - Memory: Greater or equal 2 Gigabyte
    - Hard Disk Drive: Greater or equal 250 Gigabyte
    - Power Consumption: less than 100W
    - System Inlet Temperature: 10 – 35 °C
    - Relative Humidity: 10 – 90%
    - Type: Space Saving
- The controller shall be capable of management by the remote control from an operation PC.
- Printer prints out required information in monochrome in A4 or A3 paper.

11.5 Communication Interface

- The controller shall have the network adapter such as the Ethernet adapter.
- The controller 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.

11.6 Installation

- The controller shall be capable of installing on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The controller shall have database system such as Oracle or MySQL or etc.
- 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.

12. 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. However, if it is defined for each equipment on requirement specification then shall be in accordance with the conditions.

  For Regional Main Center, Road Management Office, Toll Management Center, and Toll Office

  Temperature: 25 +/- 3 degree Celsius in average

  Relative humidity: between 20 and 80 % in average

  For outside

  Temperature: between - 0 and +50 degree Celsius

  Relative humidity: below 95 %
- It is recommended that the lighting condition of 200 lux is provided to allow easy operation and maintenance in the Regional Main Center.

13. Power Supply

- The nominal characteristics of the main supply are 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.

14. 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 DRVN, 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 DRVN, and the manufacturer 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 a copy of the ISO9001 authentication document specified above attached with tender or prequalification proposal.

16. 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN 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 the 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
- ITU-T X.200, ISO/IEC 7498-1: Information Technology – Open Systems Interconnection – Basic Reference Model: The Basic Model (OSI Reference Model)
- IETF RFC 791: Internet Protocol (IP)
- IETF RFC 793: Transmission Control Protocol (TCP)
- IETF RFC 768: User Datagram Protocol (UDP)
- IETF RFC 854: Telnet Protocol Specification
- IETF RFC 894: A Standard for the Transmission of IP Datagrams over Ethernet Networks (IP over Ethernet)
- IETF RFC 1157: Simple Network Management Protocol (SNMP)
- IETF RFC 2460: Internet Protocol , Version 6 (IPv6) Specification
- IETF RFC 4335: The Secure Shell (SSH) Session Channel Break Extension
- BS 7430: Earthing
- BS 6651: Lightning Protection

- TCVN 8078: 2009 Internet Protocol Gateway (IP Gateway) – Technical Requirements
- TCVN 9385:2012 Protection of structures against lightning – Guide for design, inspection and maintenance

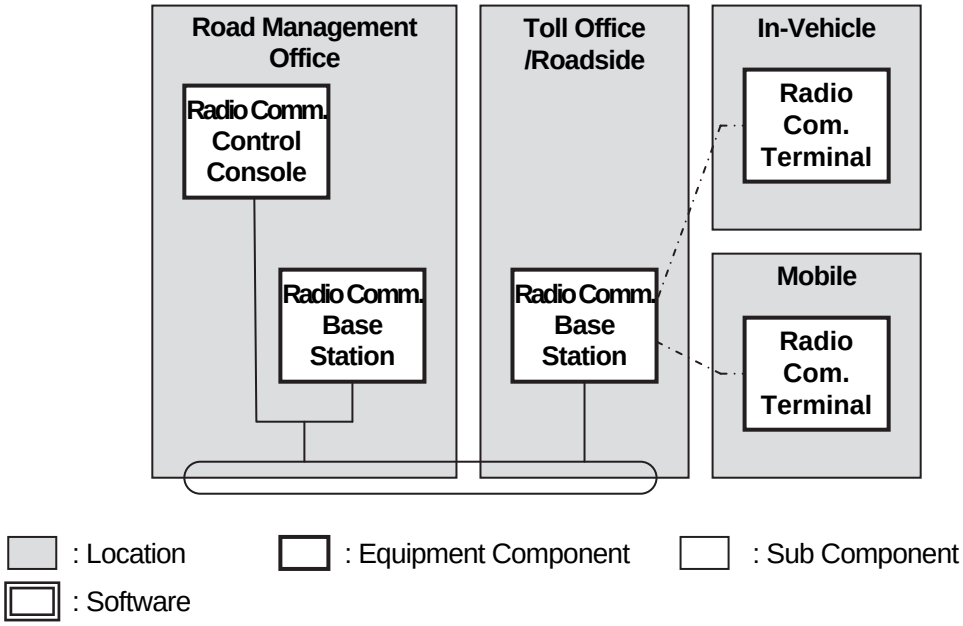
4. Requirements

- 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 or patrol crew to the Road Management Office.
- System shall be capable of sending directives to the units concerned simultaneously for clearing incidents and enforcing traffic regulations from the Road Management Office even though the receiving side using the terminal as normal communication.
- Full duplex communication method shall be applied for interactive voice communication.
- The client shall obtain necessary license from Radio Frequency Directorate of Ministry of Information and Communication. The Client shall be responsible for budgeting of operation and maintenance cost including license fee. The contractor shall support the client for preparation of application of the license and other required documents.
- The MOT shall be capable of instructing the manager of the system and of disclosing the specifications of the existing system in case there is an associated existing system.

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 the Road Management Office and the terminal equipment component users who belong to the Road Management Office.
- In emergency cases when the operator on duty in the Road Management Office receives emergency call from expressway user or directive communication from the 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 to be applied shall be VHF or UHF.
- The radio communication base station 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 base station equipment components of base station shall be types whose functions have been confirmed by the business users in foreign countries other than the country of manufacture.
- Necessary license for radio frequency and equipment components to be utilized as base station shall be obtained from Radio Frequency Directorate of Ministry of Information and Communication.

6.2 Structure

- The radio communication base station equipment component to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- 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 necessary reliability to fulfil the specified MTBF in the following clause.
- 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 the 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 speech quality design and threshold shall be as follows;
  - (i) The speech quality on the expressway should be within 25dB of S/N (Signal-to-Noise) ratio for normal modulation.
  - (ii) During design stage, in order to secure the above S/N ratio, speech quality should be checked by the site survey taking necessary margins into consideration.
  - (iii) The terminology of "normal modulation" in item (i) above means ±1.75KHz frequency modulation due to 1 KHz input signal.
  - (iv) The specified S/N ratio in item (i) is the threshold for the measurement result specified in the clause of Testing/Inspection and taking necessary margins mentioned above item (ii) into account.
- 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.
- This equipment component's min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

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.
- When the fault occurs in a base station, NMS shall be ~~is~~ detected and capable to notify it to the O&M staff of NMS as alert such as buzzer or alert screen on the display.

6.5 Communication Interfaces

- All interfaces of radio communication equipment components to be installed in the 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, allowed transmitting power and construction design based on the site survey on speech quality.
- The location of Base Station shall be selected within the premises of the Road Management Office, the 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 earthing of lightning protection system and other earthing 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. Radio Communication Control Console

7.1 Functions

- In emergency cases when the Road Management Office receives emergency call from expressway user or directive communication from the Regional Main Center, the radio communication console at the 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 directive communication console shall be capable of displaying the acknowledgement from the terminal which receives the directive.
- 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 country of manufacture.

7.2 Structure

- The radio communication console equipment component to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The radio communication console equipment component shall have necessary reliability to fulfil the specified MTBF in the following clause.
- Radio communication console equipment components shall allow replacing faulty parts simply and easily when a fault is detected.
- 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 the structure which is possible to fix in the building in the Regional Main Center.
- The structure of the Radio Communication Console shall be capable to implement the periodical checking and clean-up activities.

7.3 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 speech quality design and threshold shall be as follows;
  - (i) The speech quality on the expressway should be within 25dB of S/N (Signal-to-Noise) ratio for normal modulation.
  - (ii) During design stage, in order to secure the above S/N ratio, speech quality should be checked by the site survey taking necessary margins into consideration.
  - (iii) The terminology of "normal modulation" in item (i) above means ±1.75KHz frequency modulation due to 1 KHz input signal.
  - (iv) The specified S/N ratio in item (i) is the threshold for the measurement result specified in the clause of Testing/Inspection and taking necessary margins mentioned above item (ii) into account.
- 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.
- This equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

7.4 Human Machine Interfaces

- The radio communication console at the 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 the Road Management Office shall ~~be~~ equipping human machine interface which is able to receive directive from the Regional Main Center.
- When the fault occurs on the Radio Communication Control Console, the NMS shall be capable to detect it and notify it to the O&M staff of NMS as alert such as buzzer or alert screen on the display.

7.5 Communication Interfaces

- All interfaces of radio communication console equipment components to be installed in the Road Management Office shall be compatible with other connecting radio communication equipment components and shall not be a hindrance of 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 Radio Communication Console shall be installed in the 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.
- In case that some parts of function required are realized by some pieces of software, it 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 earthing of lightning protection system and other earthing 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 Terminal

8.1 Functions

- The radio communication terminal equipment component shall equip directive notification alert such as buzzer for the terminal user when it receives directive communication.
- The radio communication terminal equipment component shall equip response function to acknowledge a directive to the console in the 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 to be 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~~ country of manufacture.
- Necessary license for radio frequency and radio communication terminal equipment to be utilized shall be obtained from Radio Frequency Directorate of Ministry of Information and Communication.

8.2 Structure

- The radio communication terminal equipment component to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable
- The equipment components shall have suitable shape, size, lightweight and robustness for hand carried use.
- The equipment components shall be protected with measures against interference from other electronic devices.
- The radio communication terminal equipment component shall have necessary reliability to fulfil the specified MTBF in the following clause.
- The structure of Radio Communication Terminal shall be capable to replace the faulty parts simply and easily when it is detected.

8.3 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.
- This equipment component's min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

8.4 Human Machine Interfaces

- The radio communication terminal equipment component shall have human-machine interface of directive notification alert such as buzzer for the terminal user when it receives directive communication.
- The radio communication terminal equipment component shall equip response function to acknowledge a directive to the console in the Road Management Office after terminal user acknowledges receiving the directive communication.

8.5 Communication Interfaces

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

9. Ambient Conditions

- The radio communication equipment component to be installed in the 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.

10. Power Supply

- The nominal characteristics of the main supply are 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.
- 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.

11. Maintainability

- The equipment components shall allow easy and simple maintenance.
- 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 DRVN, 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
- The manufacturer/supplier of the radio communication equipment components is recommended to make a contract for technical support of operation and maintenance related to the delivered equipment components with the DRVN. The manufacturer/supplier should 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 submit a copy of the ISOI9001 authentication document as a part of the 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

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

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

(9) Prior to handover, the DRVN, PMU3, responsible organization of O&M of the equipment components, the consultant and the related party will inspect all equipment components at roadside, the Regional Main Center and the Road Management Offices in order to verify the quantity of the equipment components with the contract conditions. The Contractor shall show each equipment component at site and shall bear the necessary cost of this inspection.

3) Measurement method of input signal strength of receiver and noise intensity

This measurement method should be applied to the contractor's design stage and final inspection time.

Input signal strength of receiver and noise intensity are measured with the following procedure;

(i) Measurement of input signal strength of the receiver should be made under the condition of transmitting from base station and receiving of mobile terminal.

(ii) Whole measurement result of input signal strength of receiver is required to record along each 100m interval of expressway, and data analysis should be made for lower 25% measured result. In addition, elevated section of expressway such as inter change, the Road Management Office area, the Toll Office, rest area, and parking areas is also required to measure.

(iii) Measurement of noise intensity should be made for 10 minutes duration in accordance with the CISPR standard for the above 25% lower signal strength points, and at the same time, number of passing vehicles also should be counted. The noise intensity measurement for base station should be made under the similar conditions of actual antenna installation conditions such as height and location. As for noise intensity measurement for mobile terminal is also made under the similar conditions of actual operation such as utilization of vehicle mounted antenna and parking shoulder part of the expressway.

If there is very few vehicle passage observed during measurement, it is able to refer to the measurement result of in-service expressway section's measurement record.

(iv) Analysis of measurement result of noise intensity is made based on the recorded data, and required to obtain to calculate 50%-value (medium value) and 95%-value.

(v) The S/N ratio is obtained for the location where the measured result of input signal strength of receiver is rather low mentioned above item (ii), and the 95%-value of noise intensity explained above item (iv) at the same location is utilized.

4) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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.

5) Other Conditions

The following conditions shall be as per the related clauses of the contract conditions;

(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 DRVN and the consultant

(4) The necessary number of submission of 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 Regional Main Center 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

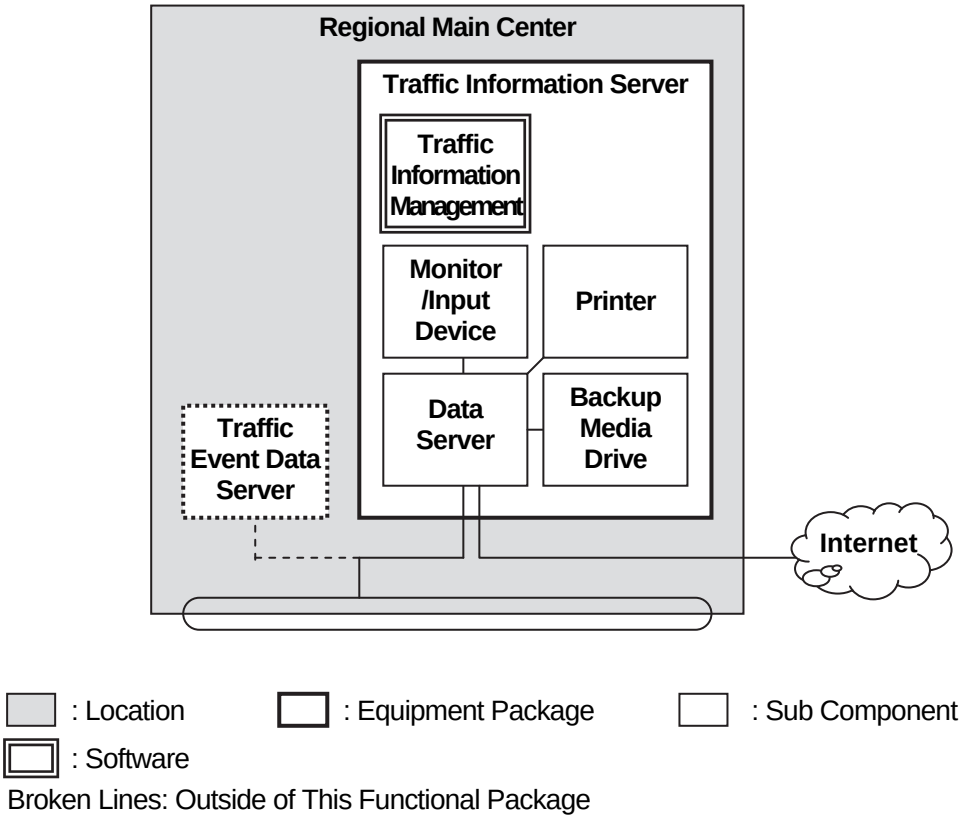
4. Requirements

- System shall be capable of 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 stored in the server.
- System shall be capable of disseminating information, which includes the contents of incidents, traffic conditions, traffic congestion, bad weather, construction work, 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 (and also output as electronic data) about these reports.
- The MOT shall be capable of instructing the manager of the system and of disclosing the specifications of the existing system in case there is an associated existing system.

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

- The server shall be capable of displaying and printing out the traffic information data related data obtained by Traffic Event Data Server.
- The server shall be capable of storing the traffic information data.
- The server shall be capable of making backup of the stored data.
- The server shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period and power outage period.

6.2 Structure

- The server shall be protected with measures against lightning.
- The chassis of server shall not be opened easily, and its door shall have a lock.
- The chassis of server shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The server shall be protected with measures against interference from other electronic devices
- The server shall have the structure which is possible to fix in the building in the Regional Main Center and the Road Management Offices.
- The structure of server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the server shall be capable to implement the periodical checking and clean-up activities.

6.3 Performance

- The Server shall have the following performance;
    - Number of CPU Core: Greater or equal 4 cores
    - Memory：Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 300 Gigabyte
    - Corresponding to the Hot Plug function
    - Power Consumption: less than 800W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: rack mount

- The Server (Blade Server) shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).
- The server shall be capable of printing out the report of disseminated information.
- The 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 server shall be capable of transmitting the traffic information data to Traffic Information Server at the Regional Main Center and the Road Management Offices.
- The server shall be capable of storing traffic information data.
- The server shall be capable of retrieving and displaying the transaction records which are stored Traffic Information Data by using retrieve condition elements which are input by using “Data Input Device”
- The Server shall have storage capacity to store all data on traffic information 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 back up 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 server shall be capable of executing the restoration of backup data.

6.4 Human Machine Interface

- The server shall be capable of management by the remote control from an operation PC.
- The operation PC shall have the following performance.
  - Number of CPU Core: Greater or equal 2 core
  - Memory: Greater or equal 2 Gigabyte
  - Hard Disk Drive: Greater or equal 250 Gigabyte
  - Power Consumption: less than 100W
  - System Inlet Temperature: 10 – 35 °C
  - Relative Humidity: 10 – 90%

- Type: Space Saving

- The PC shall have equipment such as keyboard and optical mouse.

6.5 Communication Interface

- The server shall have the network adapter such as the Ethernet adapter.
- The server shall be capable of transmitting all data and signal 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 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 shall be capable of installing on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The server shall have database system such as Oracle or MySQL or etc.
- The server shall be installed in the Regional Main Center.
- The server shall have web server software such as apache or IIS 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 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

7. Traffic Information Server (Traffic Information Management)

7.1 Functions

- The system shall be capable of retrieving data from Traffic Event Data Server in the Regional Main Center in order to compiling traffic information for broadcast. The broadcast information contains traffic, road conditions, incidents, weather information, and other related information.
- The system shall be capable of generating 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 system shall be capable of disseminating traffic conditions and incident information to internet users with text and traffic map.
- The system 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 system 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.

7.2 Performance

- The system shall be capable of retrieving from Traffic Event Data Server in the Regional Main Center, compiling it, and broadcasting incident information to internet users.
- The system shall be capable of retrieving from Traffic Event Data Server in the Regional 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 system shall be capable of disseminating traffic conditions and incident information to internet users with text and traffic map.
- The system 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 system 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 system shall be capable of automatically updating of traffic information.

7.3 Human Machine Interface

- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

7.4 Communication Interface

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

7.5 Installation

- The system 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 office which is protected from interferences of other electronic devices.
- The equipment components shall be capable of operating normally under the following ambient conditions: However, if it is defined for each equipments on requirement specification then shall be in accordance with the conditions.

  For Regional Main Center, Road Management Office, Toll Management Center, and Toll Office

  Temperature: 25 +/- 3 degree Celsius in average

  Relative humidity: between 20 and 80 % in average

  For outside

  Temperature: between - 0 and +50 degree Celsius

  Relative humidity: below 95 %

- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Regional Main Center.

9. Power Supply

- The nominal characteristics of the main supply are 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 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 DRVN, 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 DRVN, 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and

the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN and the consultant

(4) The necessary number of submission documents

(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 Regional 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

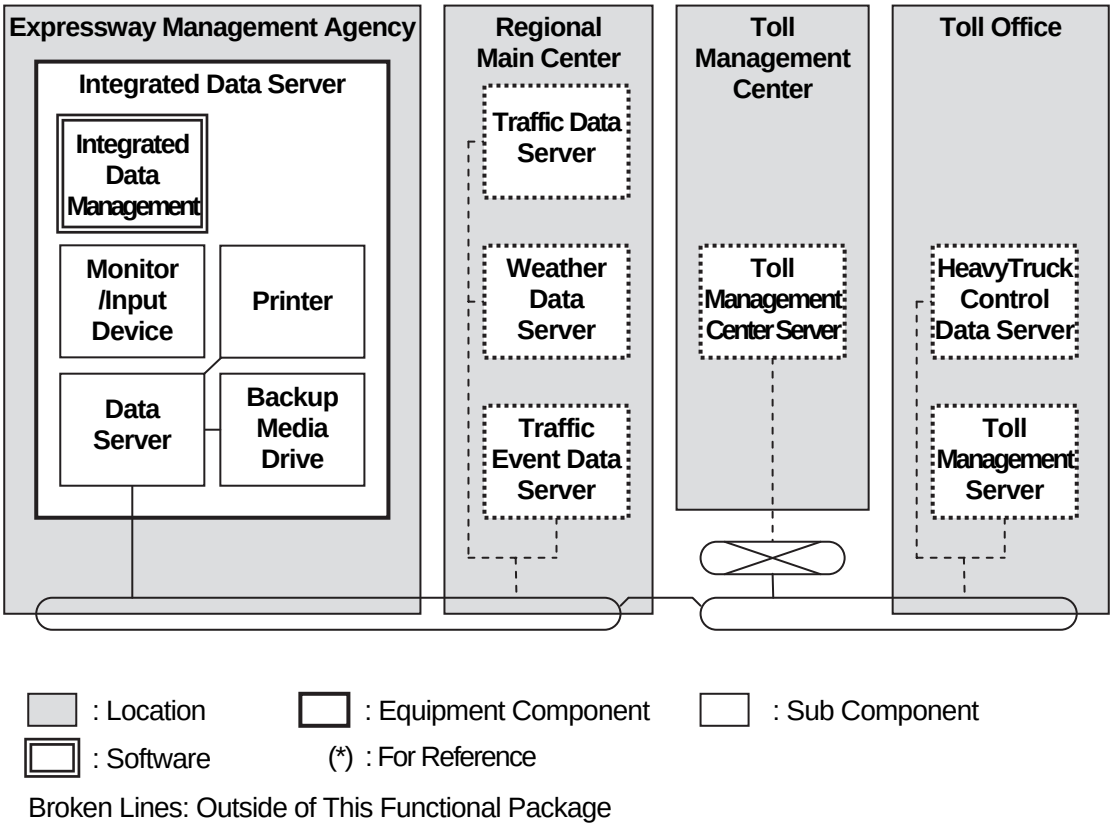
4. Requirements

- 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, 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/output the historical data records in the form of list, table and graph as electronic data.
- System shall be capable of searching/calculating values required for checking validity of toll revenue in comparison with traffic data.
- The MOT shall be capable of instructing the manager of the system and of disclosing the specifications of the existing system in case there is an associated existing system.

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

- The server shall be capable of retrieving data from Traffic Event Data Server in the Regional Main Center in order to compiling traffic event for management.
- The server shall be capable of retrieving data from Heavy Truck Control Server in the Toll Office in order to compiling axle load measurement data for management.

6.2 Structure

- The server shall be protected with measures against lightning.
- Chassis of server shall not be opened easily, and the door on the chassis shall be equipped with a lock.
- Chassis of server shall be capable of dissipating temperature rising from inside equipment.
- The server shall be protected with measures against interference from other electronic devices
- The structure of server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the server shall be capable to implement the periodical checking and clean-up activities.
- The server of Integrated Data Server shall be installed in the Regional Main Center.

6.3 Performance

- The server shall have storage capacity to store all data on traffic event and axle load measurement.
- The 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 Data Server shall have the following performance;
    - Number of CPU Core: Greater or equal 4 cores
    - Memory：Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 300 Gigabyte
    - Corresponding to the Hot Plug function
    - Power Consumption: less than 800W
    - System Inlet Temperature: 5 – 35 °C

- Relative Humidity: 15 – 85%
- Type: rack mount

- The server (Blade Server) shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).
- 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 back up 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 server shall be capable of displaying the retrieved results on the monitor screen by operation PC.
- The server shall be capable of printing information which is displayed on Monitor Screen by operation PC.
- Recommended size of monitor screen shall be (approx.) 20 inches or over.
- All consoles shall have user-friendly interface.
- Printer prints out required information in monochrome in A4 and A3 paper.

6.4 Human Machine Interfaces

- The server should be equipped with necessary Human Machine Interfaces such as monitor, keyboard, and mouse.
- The server shall be capable of management by the remote control from an operation PC.
- The operation PC shall have the following performance.
  - Number of CPU Core: Greater or equal 2 core
  - Memory: Greater or equal 2 Gigabyte
  - Hard Disk Drive: Greater or equal 250 Gigabyte
  - Power Consumption: less than 100W
  - System Inlet Temperature: 10 – 35 °C
  - Relative Humidity: 10 – 90%
  - Type: Space Saving
- The server shall be capable of management by remote control.

6.5 Communication Interfaces

- The server shall have the network adapter such as the Ethernet adapter.
- The server 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 shall be installed in the Regional Main Center.
- The 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 server shall be installed in air conditioned room in the 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. Integrated Data Server (Integrated Data Management)

7.1 Functions

- The system shall be capable of displaying history of traffic event and toll revenue and axle load measurement data to VEA with table and graph.

7.2 Performance

- The system shall be capable of compiling statistical data and making reports: daily report, weekly report, monthly report, and yearly report.
- 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 saving the compiled data in CSV format. It shall be capable of being accessed and modified using commercially application software (such as Microsoft Excel).
- Language on system software shall be capable of being displayed in Vietnamese and English except for the geographic name.

7.3 Human Machine Interfaces

- The screen shall have user-friendly interface.
- The system shall be capable of using a human machine interface for displaying the statistical data on the screen and printing it out.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

7.4 Communication Interfaces

- 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.

7.5 Installation

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

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 components shall be capable of operating normally under the following ambient conditions: However, if it is defined for each equipments on requirement specification then shall be in accordance with the conditions.

  For Regional Main Center, Road Management Office, Toll Management Center, and Toll Office

  Temperature: 25 +/- 3 degree Celsius in average

  Relative humidity: between 20 and 80 % in average

  For outside

  Temperature: between - 0 and +50 degree Celsius

  Relative humidity: below 95 %
- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Regional Main Center.

9. Power Supply

- The nominal characteristics of the main supply are 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 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 DRVN, 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 DRVN, 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 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN and the consultant

(4) The necessary number of submission documents

(13)
Tollgate Lane Monitoring
(For Reference)

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 the 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)

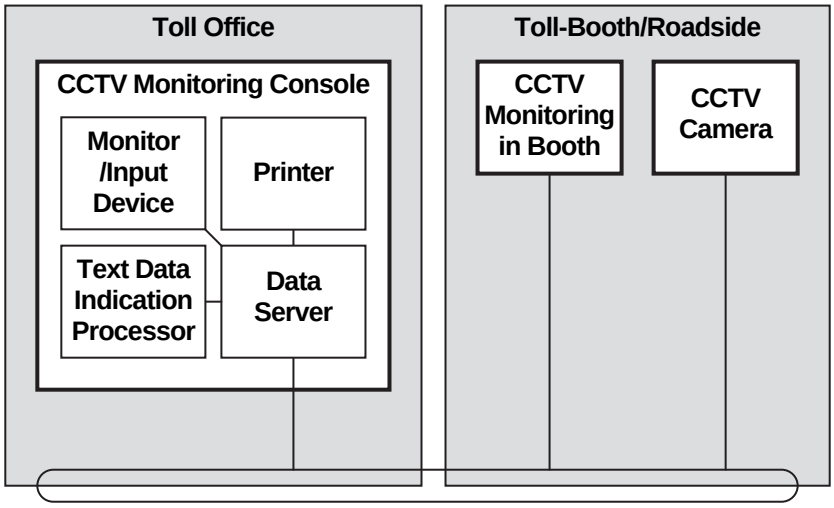
4. Requirements

- System shall be capable of monitoring vehicles passing through a tollgate lane at the tollbooths and the Toll Office, and identifying their type of vehicle such as trailer, semi-trailer, bus, and passenger car by visual observation.
- System shall be capable of monitoring toll payment / receipt transaction between a driver and a toll collector at the Toll Office.
- System shall be capable of controlling the roadside equipment remotely at the Toll Office.
- 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 such as the video image of violation / vandalisation occurrence.
- System shall be capable of displaying, output the needed video images (soft copy) and printing out the needed images.

5. System Architecture

System architecture for tollgate lane monitoring is shown below.

Figure 5.1 System Architecture for Tollgate Lane Monitoring



: Location : Equipment Component : Sub Component
: 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 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 requirements 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 tollbooth:

- 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 tollbooth 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 tollbooth.

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.
- 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 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 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 tollbooth 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 tollbooth 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 tollbooth.

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 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 operator on the monitor.
- Recommended size of monitor screen is (approx.) 20 inches or over.
- The system shall allow operator to monitor all displayed images.
- 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.
- The CCTV Monitoring Console shall have the following performance.
    - Number of CPU Core: Greater or equal 4 core
    - Memory: Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 1 Terabyte
    - Power Consumption: less than 700W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: Tower style

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, tollbooth, 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. However, if it is defined for each equipments on requirement specification then shall be in accordance with the conditions.

For Regional Main Center, Road Management Office, Toll Management Center, and Toll Office

Temperature: 25 +/- 3 degree Celsius in average
Relative humidity: between 20 and 80 % in average

For outside

Temperature: between - 0 and +50 degree Celsius

Relative humidity: below 95 %

- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Toll Management Ceter and the Toll Office.

10. Power Supply

- The nominal characteristics of the main supply are 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.

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 DRVN, 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 DRVN. 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN and the consultant

(4) The necessary number of submission documents

(14)
Vehicle/Class Identification
(For Reference)

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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)

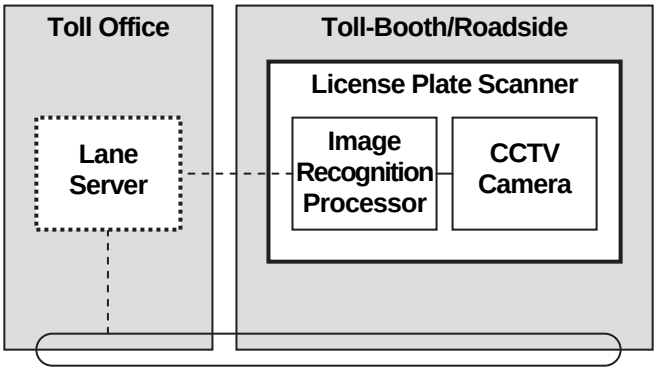
4. Requirements

- System shall be capable of monitoring vehicles passing through a tollgate lane at the Toll Booth and the Toll Office, and identifying their type of vehicle such as trailer, semitrailer, bus, and passenger car by visual observation.
- System shall be capable of measuring, number of vehicles, vehicle speed at a specific point on the road.
- System shall be capable of recognizing vehicle number plate, to convert textural information.
- System shall be capable of displaying the image and the textural number plate of the vehicle on the monitor console in the Toll Booth, when the vehicles enter a tollgate lane.
- System shall be capable of storing the image and textural information of vehicle number plate.
- System shall be capable of measuring, number of vehicles by trailers, semitrailers and another type of vehicle by using number plate information.
- System shall be capable of controlling the roadside equipment remotely at the Toll Office.
- System shall be capable of minimizing load caused by data transmission, including video image on the communication system.
- System shall be capable of displaying, output the needed data (soft copy), and printing out the needed information.

5. System Architecture

System architecture for vehicle/class identification is shown below.

Figure 5.1 System Architecture for Vehicle/Class Identification



: Location : Equipment Component : Sub Component

: Software

Broken Lines: Outside of This Functional Package

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 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.
- 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 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: However, if it is defined for each equipments on requirement specification then shall be in accordance with the conditions.

  For Regional Main Center, Road Management Office, Toll Management Center, and Toll Office

  Temperature: 25 +/- 3 degree Celsius in average

  Relative humidity: between 20 and 80 % in average

  For outside

  Temperature: between - 0 and +50 degree Celsius

  Relative humidity: below 95 %
- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Toll Management Ceter and the Toll Office.

9. Power Supply

- The nominal characteristics of the main supply are 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 DRVN, 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 DRVN, 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of

authorized staff of DRVN and/or the consultant.

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN and the consultant

(4) The necessary number of submission documents

(15)
Lane Control
(For Reference)

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1. General Outline

This functional package allows the road operators to eliminate the vehicle passages without 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

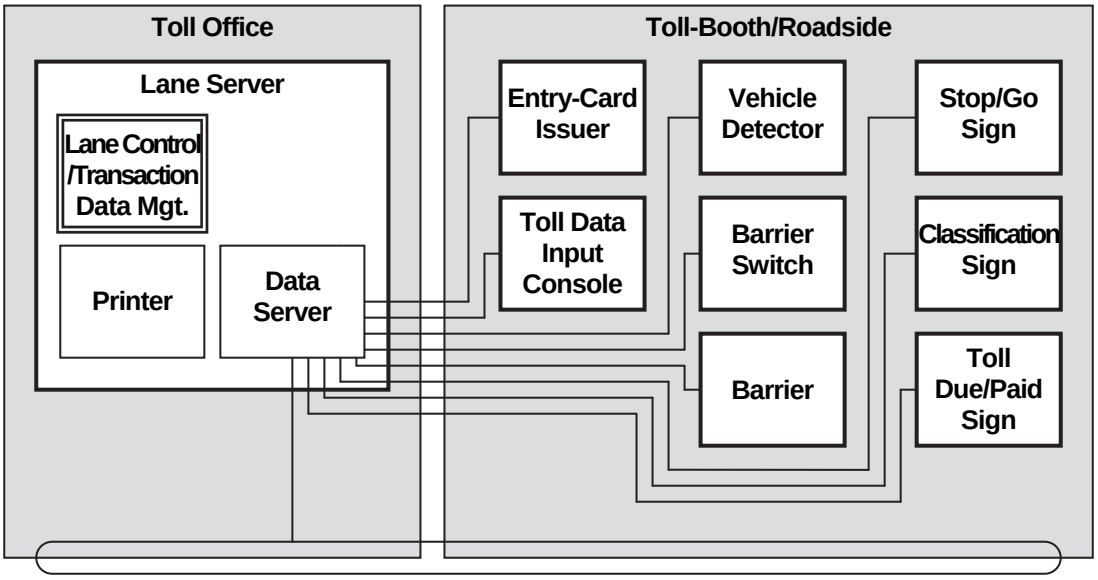
4. Requirements

- System shall be capable of generating/processing the data appropriate for collecting tolls based on the data sent from IC-card and OBU based on the regulated toll rate system.
- System shall be capable of generating/processing the data appropriate for collecting tolls based on the data from Entry-Card with 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 tolls and giving the vehicle class by OBU/IC-card, in case of electric toll collection.
- System shall be capable of processing the data for collecting tolls and giving the vehicle class recognized by toll collector a higher priority, in case of manual toll collection.
- System shall be capable of storing the image and textural information of vehicle number plate with the vehicle class which is recognized by toll collector and OBU/IC-card.
- System shall be capable of accepting the settlement method such as by cash, prepaid and post-paid.
- System shall be capable of checking the prepaid balance of IC-card at Toll-Booth.
- System shall be capable of notifying a driver, in case of prepaid balance shortage for required toll amount, the necessity to recharge the prepaid balance before the next passage at the tollgate lane, indicating the amount due.
- System shall be capable of controlling Barrier automatically according to the processing result of toll collection.
- System shall be capable of blocking the vehicles without normal completion of toll collection by using Barrier and Barrier Switch.
- System shall be capable of generating/storing identification data of the vehicles.
- System shall be capable of displaying, output the needed data (soft copy), and printing out the needed information.
- 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 checking by toll collector.
- System shall be capable of functioning in 24/7 by a redundant system.

5. System Architecture

System architecture for lane control is shown below.

Figure 5.1 System Architecture for Lane Control



: Location : Equipment Component : Sub Component

: Software

Broken Lines: Outside of This Functional Package

6. Lane Server

6.1 Functions

- To receive the data from “Roadside Controller”, “IC-Card R/W” and “Toll Data Input Device” at the Entry Tollgate.
- To transmit the data to “Roadside Controller”, “IC-Card R/W” and “Toll Data Input Device” at the Entry Tollgate.
- To receive the data from “Roadside Controller”, “IC-Card R/W” and “Toll Data Input Device” at the Exit Tollgate.
- To transmit the data 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 from “IC-Card R/W”, and shall be capable of transmitting the data to “IC-Card R/W”.
- At exit tollgate: The equipment components shall be capable of receiving the data from “IC-Card R/W”, and shall be capable of transmitting the data 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 from “Roadside Controller”, and shall be capable of transmitting the data to “Roadside Controller”.
- At exit tollgate: The equipment components shall be capable of receiving the data from “Roadside Controller”, and shall be capable of transmitting the data 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 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 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 storing the “Invalidation-list” received from “Toll Office Server”. The Invalidation list is described in the table below.
- 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.
- The CCTV Monitoring Console shall have the following performance.
  - Number of CPU Core: Greater or equal 4 core
  - Memory: Greater or equal 8 Gigabyte
  - Hard Disk Drive: Greater or equal 1 Terabyte
  - Power Consumption: less than 700W
  - System Inlet Temperature: 5 – 35 °C
  - Relative Humidity: 15 – 85%
  - Type: Tower style
- Printer prints out required information in monochrome in A4 and A3 paper.

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".
- 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, 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

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

6.4 Human Machine Interface

- 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 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 the 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. Lane Server (Lane Control/Transaction Data Management)

7.1 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".

7.2 Performance

- 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 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.
- 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 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

7.3 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.

7.4 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.

7.5 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 of Data Server.

8. Toll Data Input Console

8.1 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” 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.

8.2 Structure

- The equipment components shall be protected with measures against interference from other electronic devices.
- 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.

8.3 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.

8.4 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.

8.5 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.

8.6 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

9. Barrier

9.1 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.

9.2 Structure

- Solid barriers shall be designed to avoid damage from vehicle contact.
- 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.

9.3 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.

9.4 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.

9.5 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.

10. Barrier Switch

10.1 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.

10.2 Structure

- 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.

10.3 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.

10.4 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.

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 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.

11. Toll Due/Paid Sign

11.1 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.

11.2 Structure

- 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

11.3 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.

11.4 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.

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. Stop/Go Sign

12.1 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.

12.2 Structure

- 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.

12.3 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.

12.4 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.

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 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.

13. Entry-Card Issuer

13.1 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.

13.2 Structure

- 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.

13.3 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”

13.4 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.

13.5 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.

13.6 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.

14. Classification Sign

14.1 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.

14.2 Structure

- 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.

14.3 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.

14.4 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.

14.5 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.

14.6 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.

15. Vehicle Detector

15.1 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.

15.2 Structure

- 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.

15.3 Performance

- The equipment components shall be capable of transmitting the measured number of vehicle. Passing through Toll lane.

15.4 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.

15.5 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.

16. 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: However, if it is defined for each equipments on requirement specification then shall be in accordance with the conditions.

For Regional Main Center, Road Management Office, Toll Management Center, and Toll Office

Temperature: 25 +/- 3 degree Celsius in average
Relative humidity: between 20 and 80 % in average

For outside

Temperature: between - 0 and +50 degree Celsius
Relative humidity: below 95 %

- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Toll Management Ceter and the Toll Office.

17. Power Supply

- The nominal characteristics of the main supply are 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.

18. 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 DRVN, 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 DRVN, and the manufacturer shall provide the necessary services based on the contract.

19. 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.

20. 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

(3) The factory inspection is recommended to be implemented with the witness of

authorized staff of DRVN and/or the consultant.

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN and the consultant

(4) The necessary number of submission documents

(16)
Road-to-Vehicle Communication
(For Reference)

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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

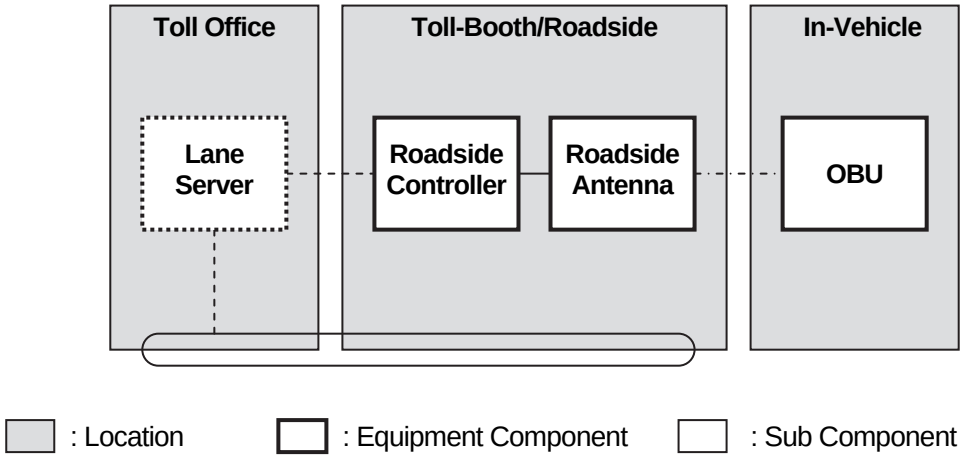
4. Requirements

- 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 accepting the settlement method such as by prepaid and postpaid IC-card.
- System shall be capable of functioning in 24/7 by a redundant system without the maintenance or replacement period of time.

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 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 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.

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 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 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: However, if it is defined for each equipments on requirement specification then shall be in accordance with the conditions.

  For Regional Main Center, Road Management Office, Toll Management Center, and Toll Office

Temperature: 25 +/- 3 degree Celsius in average
Relative humidity: between 20 and 80 % in average

For outside

Temperature: between - 0 and +50 degree Celsius
Relative humidity: below 95 %

- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Toll Management Ceter and the Toll Office.

10. Power supply

- The nominal characteristics of the main supply are 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.

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 DRVN, 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 DRVN. 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own

connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN and the consultant

(4) The necessary number of submission documents

(17)
IC-Card Recording
(For Reference)

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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

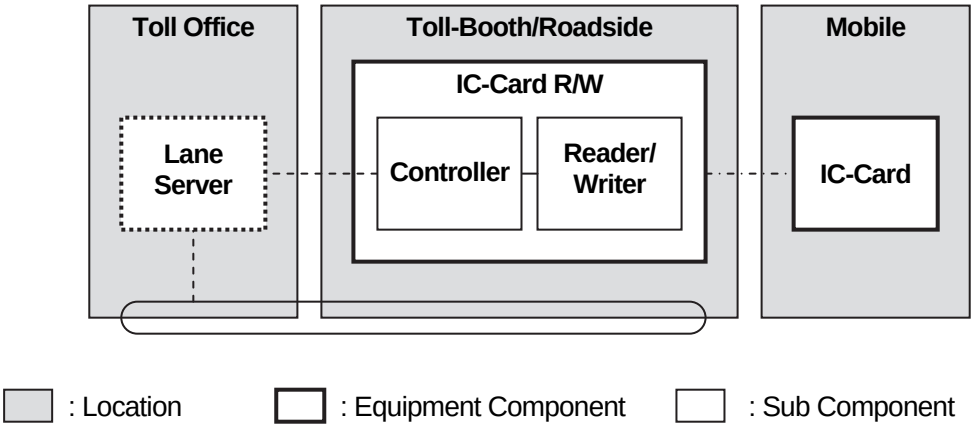
- System shall be capable of notifying the data for collecting toll and the results of processing the data.
- System shall be capable of allowing securing an average service-time by one-stop collection of less than 9.0 sec/vehicle.

  (*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.

5. System Architecture

System architecture for IC-card recording is shown below.

Figure 5.1 System Architecture for IC-card Recording



: Location : Equipment Component : Sub Component

Broken Lines: Outside of This Functional Package

6. IC-Card

6.1 Functions

- “IC-Card” shall be capable of recording the data on Contactless IC-Card, such as ID number, usage history information (date, entry and exit IC, 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).
- “IC-Card” shall be capable of storing up to 10 records of toll collection and recharging 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 6.1 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

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".
- 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 IC-Card R/W shall be capable of writing the data controlled by "Lane Server".
- The IC-Card R/W shall be capable of reading the toll collection history data stored in "IC-Card".
- The IC-Card R/W 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 IC-Card R/W shall be capable of communicating with IC cards by radio communication.
- The IC-Card R/W shall be capable of synchronizing its clock to the clock of "Traffic Supervising / Control Server" at start-up.
- The IC-Card R/W shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period and during power outage.
- After operation recovery from the power failure, to automatically switch on the equipment components and the software.

7.2 Structure

- The IC-Card R/W 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 IC-Card R/W shall be protected with measures against typhoon, fire, earthquake, sandstorm, and lightning.
- The IC-Card R/W shall be protected with measures against water, rust, dust, salt water in case that equipment component is installed outdoors.
- The IC-Card R/W 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 IC-Card R/W shall not be opened easily, and its door shall have a lock.
- The IC-Card R/W 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 IC-Card R/W shall be capable of dissipating temperature rising from inside

equipment and radiant solar heat.

- The IC-Card R/W 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 R/W shall be capable of transmitting specified carrier wave, power, and data to “IC-card”.
- The IC-Card R/W shall be capable of capturing the change of magnetic flux from “IC-Card” for receiving data.
- The IC-Card R/W 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 IC-Card R/W shall be capable of preparing a countermeasure for prompt and credible transaction, such as “multiple calling”.
- The IC-Card R/W 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 sign” in “IC-Card”. In case “Prepaid balance” is lower than the amount has to be paid, it will notify the driver and send “Warning command” to “Lane Server”.
- The system shall be capable of writing Remark on "Termination sign" 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 R/W shall be capable of checking whether the most recent transmission was done at Entry Interchange or Exit Interchange by using "Termination sign" 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 R/W 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 IC-Card R/W 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 IC-Card R/W shall be capable of notifying normal/abnormal 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 7.1 Communication Interface between “IC-Card Reader/Writer” and “IC-Card”

Item	Specifications
Main carrier wave	13.56MHz
Modulation method	ASK
Encoding method	NRZ-L or Manchester or Modified Miller

- 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 IC-Card R/W 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 IC-Card R/W 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, IC-Card R/W is installed at Touch and Go lane. The IC-Card 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, IC-Card R/W is 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: However, if it is defined for each equipments on requirement specification then shall be in accordance with the conditions.

  For Regional Main Center, Road Management Office, Toll Management Center, and Toll Office

  Temperature: 25 +/- 3 degree Celsius in average

  Relative humidity: between 20 and 80 % in average

For outside

Temperature: between - 0 and +50 degree Celsius

Relative humidity: below 95 %

- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Toll Management Ceter and the Toll Office.

9. Power Supply

- The nominal characteristics of the main supply are 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 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 DRVN, 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 DRVN, 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

(4) The equipment component unit test procedure at site shall be submitted to the DRVN and the consultant for approval.

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center, the Road Management Offices and bank(s), and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN and the consultant

(4) The necessary number of submission documents

(18)
Toll Data Management
(For Reference)

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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 the 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

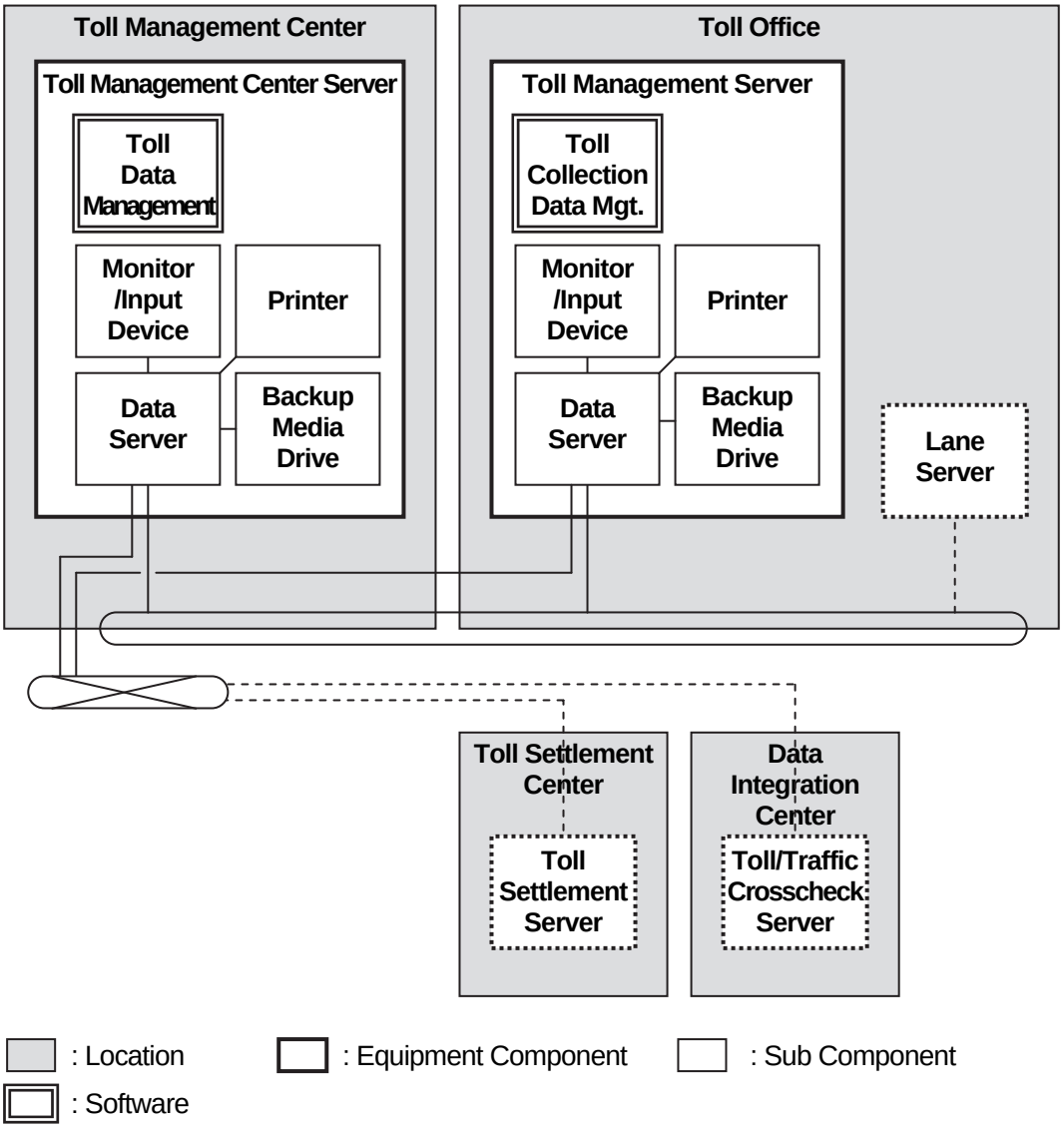
4. Requirements

- 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, except for power outage.

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

- The server shall be capable of displaying and printing out the toll collection data related to toll collection.
- The server shall be capable of storing all Transaction data and Toll collection data related to toll collection.
- The server shall be capable of making backup of the stored data.
- The server shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period and power outage period.

6.2 Structure

- The server shall be protected with measures against lightning.
- The chassis of server shall not be opened easily, and its door shall have a lock.
- The chassis of server shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The server shall be protected with measures against interference from other electronic devices.
- The structure of server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the server shall be capable to implement the periodical checking and clean-up activities.

6.3 Performance

- The server shall have the following performance;
    - Number of CPU Core: Greater or equal 4 cores
    - Memory：Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 300 Gigabyte
    - Corresponding to the Hot Plug function
    - Power Consumption: less than 800W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: rack mount
- The server (Blade Server) shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).

- The server shall be capable of transmitting the statistical data including transaction data and toll collection data to “Toll/Traffic Crosscheck Server” at “Data Integration Center”
- The server shall be capable of transmitting the Transaction data, Toll collection data to “Toll/Traffic Crosscheck Server” at “Data Integration Center”
- The server shall be capable of transmitting the Traffic volume data (through the tollgate) to “Toll/Traffic Crosscheck Server” which is located at “Data Integration Center”.
- The server shall be capable of storing all Transaction data and Toll collection data related to toll collection.
- The server 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”.
- The server shall have storage capacity to store at least 1 year data on transaction data and toll collection data.
- The server shall have storage capacity to store at least following data; Toll Rate Information Data Set, Toll Collection Data Set, Hourly Toll Collection Data Set, and Toll Revenue Data Set.
- The server shall be capable of executing backup of the stored data in the server on the date which is set up in advance.
- 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 back up 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 server shall be capable of executing the restoration of backup data.
- The server shall be capable of displaying the retrieved results on the monitor screen by operation PC.
- The server shall be capable of printing information which is displayed on Monitor Screen by operation PC.
- Recommended size of monitor screen shall be (approx.) 20 inches or over.
- All consoles shall have user-friendly interface.
- The server shall be capable of printing retrieved results by A4/A3 type printer.

6.4 Human Machine Interface

- The server shall be capable of management by the remote control from an operation PC.
- The operation PC shall have the following performance.
    - Number of CPU Core: Greater or equal 2 core
    - Memory: Greater or equal 2 Gigabyte
    - Hard Disk Drive: Greater or equal 250 Gigabyte
    - Power Consumption: less than 100W
    - System Inlet Temperature: 10 – 35 °C
    - Relative Humidity: 10 – 90%
    - Type: Space Saving
- The operation PC shall have human machine interface for “Operator” to input searching conditions to retrieve the “Transaction data” and “Toll collection data”.
- The operation PC shall have equipment such as keyboard and optical mouse.

6.5 Communication Interface

- The server shall have the network adapter such as the Ethernet adapter.
- The server 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

- The server shall be capable of installing on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The server shall have database system such as Oracle or MySQL or etc.
- The installation work shall include equipment component 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 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 lighting protection system and other grounding facilities installed within short distance.

7. Toll Management Center Server (Toll Data Management)

7.1 Functions

- The system shall be capable of receiving, compiling and manage the Transaction data, Toll collection data relating to toll collection from Toll Management Server from each Tollgate.
- The system shall be capable receiving the related information of enforcements (such as crackdown of fraud) from subordinate equipment.
- The system shall be capable of detecting a vehicle which is suspected of fraud from Enforcement Data Set.

7.2 Performance

- The system shall be capable of calculating toll amount 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, upon vehicle classification policy of the Ministry of Finance.
- The system shall be capable of automatically preparing the statistical data related to toll collection data, based on the toll collection data stored in “Toll Management Center Server”. Necessary statistical data is monthly, daily, and hourly toll collection data of each Interchanges.
- At least, the system shall be capable of calculating following toll collection data at least for one year:

- Toll collection (of all section, each interchange, vehicle type)
- Daily toll collection of each interchange and each vehicle type
- Hourly toll collection of each interchange and each vehicle type
- Monthly
- Yearly

- 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 receiving the toll collection data from "Toll Settlement 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 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 automatically updating the transaction data and toll collection data every 10 minutes.
- The system shall be capable of displaying the calculated results of toll amount into table and chart formats.
- The system 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).
- Language on system software shall be capable of being displayed in Vietnamese and English except for the geographic name.

7.3 Human Machine Interface

- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

7.4 Communication Interface

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

7.5 Installation

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

8. Toll Management Server

8.1 Functions

- The server shall be capable of storing all Transaction data and Toll collection data related to toll collection.
- The server shall be capable of synchronizing its clock to the clock of “Toll Management Center Server” at start-up. After clock synchronization, the server shall be capable of picking out required information from the database in the “Data Server”
- The server shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period and power outage period.

8.2 Structure

- The server shall be protected with measures against lightning.
- The chassis of server shall not be opened easily, and its door shall have a lock.
- The chassis of server shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The server shall be protected with measures against interference from other electronic devices.
- The structure of server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the server shall be capable to implement the periodical checking and clean-up activities.

8.3 Performance

- The server shall have the following performance.
    - Number of CPU Core: Greater or equal 4 core
    - Memory: Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 1 Terabyte
    - Power Consumption: less than 700W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: Tower style
- The server shall be capable of storing all Transaction data and Toll collection data related to toll collection.
- The server shall be capable of transmitting the Transaction data and Toll collection data to “Toll Management Center Server” which is located at “Toll Management Center”.
- The server 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”.
- The server shall have storage capacity to store at least 1 year data on transaction data and toll collection data.
- The server shall have storage capacity to store at least following data; Toll Rate Information Data Set, IC-Card Recharge Data Set, IC-Card Passage Data Set, IC-card Invalidation List Data Set, OBU Passage Data Set, OBU Invalidation List Data Set, Toll Collection License Plate Data Set, Transaction Data Set, and Toll Collection Data Set
- The server shall be capable of receiving and storing “Toll rate table” sent by “Toll Management Center Server”
- The system shall be capable to accumulate enforcement information (including image) in the database.
- Capacity of accumulation shall be sufficient for at least 50,000 vehicles / day for 12 months.
- 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 back up 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 server shall be capable of executing the restoration of backup data.
- The server shall be capable of displaying the retrieved results on the monitor screen.
- The server 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 server shall be capable of printing retrieved results by A4/A3 type printer.

8.4 Human Machine Interface

- The server shall have human machine interface for “Operator” to input searching conditions for retrieve the “Transaction data” and “Toll collection data”.
- The server shall have equipment such as keyboard and optical mouse.

8.5 Communication Interface

- The server shall have the network adapter such as the Ethernet adapter.
- The server 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.

8.6 Installation

- The server shall be capable of installing on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The server shall have database system such as Oracle or MySQL or etc.
- The installation work shall include equipment component 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 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 lighting protection system and other grounding facilities installed within short distance.

9. Toll Management Server (Toll Collection Data Management)

9.1 Functions

- The system 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 system shall be capable of receiving the related information of enforcements (such as crackdown of fraud) from subordinate equipment.
- The system shall be capable of transmitting the Transaction data to the Settlement Server at Toll Settlement Center.
- The system shall be capable of detecting a vehicle which is suspected of fraud from Enforcement Data Set
- The system shall be capable of composing the Invalidation list based on the information which is transmitted from IC-card Management 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.
- The system shall be capable of receiving the invalidation list from bank(s), and then the invalidation list shall be transmitted to Lane Server.

9.2 Performance

- The system shall be capable of calculating toll amount for the road section under management scope of the Toll Office based on Transaction data and Toll Collection data which are sent from “Lane Server”.
- The system shall be capable of calculating toll amount and traffic volume classifying by each vehicle class and by each IC card ID, upon vehicle classification policy of the Ministry of Finance.
- The system shall be capable of automatically preparing the statistical data related to toll collection data, based on the toll collection data stored in “Toll Management Server”.

Necessary statistical data is monthly, daily, and hourly toll collection data of Interchanges.

- The server shall be capable of transmitting the Transaction data and Toll collection data to "Toll Settlement Server" at "Toll Settlement 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).
- At least, the system shall be capable of calculating following toll collection data for one year:
    - Toll collection of all section, each interchange, vehicle type
    - Daily toll collection of each interchange and each vehicle type
    - Hourly toll collection of each interchange and each vehicle type
    - Monthly toll collection of each interchange and each vehicle type(5 years)
- The system shall be capable of receiving "Invalidation-list" which is recorded by ID such as stolen OBU or IC Card, from IC-card Management which is located at Settlement Centre and from /OBU Management which is located at OBU Management Center respectively.
- 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 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 system 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 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 automatically updating the transaction data and toll collection data on a real time basis.
- 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 displaying the calculated results of toll amount into table and chart formats.
- The system 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).
- Language on system software shall be capable of being displayed in Vietnamese and English except for the geographic name.

9.3 Human Machine Interface

- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

9.4 Communication Interface

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

9.5 Installation

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

10. 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 toll booths and the Toll Offices shall generally be air-conditioned and with the option of flesh air supply for ventilation.
- All equipment must be able to operate over the appropriate ranges of temperature and relative humidity generally encountered in the project area. 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: between 15 and 35 degrees Celsius in average
  Relative humidity: between 15 and 85 % in average
  For outside
  Temperature: between - 0 and +50 degree Celsius
  Relative humidity: below 95 % in average
- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Toll Management Ceter and the Toll Office.

11. Power Supply

- The nominal voltages of the main power supply shall be AC 220 volts for single phase at 50 Hz frequency. The system power supply shall be protected by an uninterrupted power supply (UPS) which can accommodate the surge or voltage variation which may occur at the mains of power supply during interruptions. UPS shall be capable of providing power for the system for more than 30 minutes.
- The work shall include all wiring, connections and power supply for the system to the each Toll Offices and each toll booths
- The contractor shall provide the power connection to the receiving panel (SS) of the each Toll Offices and shall be responsible for all wiring and connections from the power distribution board (PDB) to the each equipment in the toll booths and the Toll Offices.

12. 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.
- Notwithstanding the obligations of the Contractor under the Defects Notification Period, the Maintenance Period shall be twenty four months on the system as installed and this shall commence from the date of acceptance of the system. During this period, the equipment must be fully maintained by the contractor and the maintenance shall include for all routine, recurrent, and preventive maintenance and for all parts which may need to be replaced during this period.

- The Contractor shall submit a priced list to show the spare parts / materials forecasted to be required to ensure the continuous operation of the full system equipment during the maintenance period. The list shall in details, all the quantities of all materials required. At the date of acceptance, the parts / materials on this list shall be turned over by the contractor without charge and will then be utilized as required during the maintenance period. Any additional parts required during the maintenance period shall also be at the cost of the Contractor.
- At the end of the maintenance period all spare parts which have been used, shall be replenished free of charge and the quantities handed over to the Employer shall be those that are listed in the spare parts lists. No claim for the additional payment of spare parts shall be entertained.
- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the DRVN, 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 DRVN, and the manufacturer shall provide the necessary services based on the contract.

13. 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.

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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center, the Road Management Offices and bank(s), and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN and the consultant

(4) The necessary number of submission documents

(19)
OBU Management
(For Reference)

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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

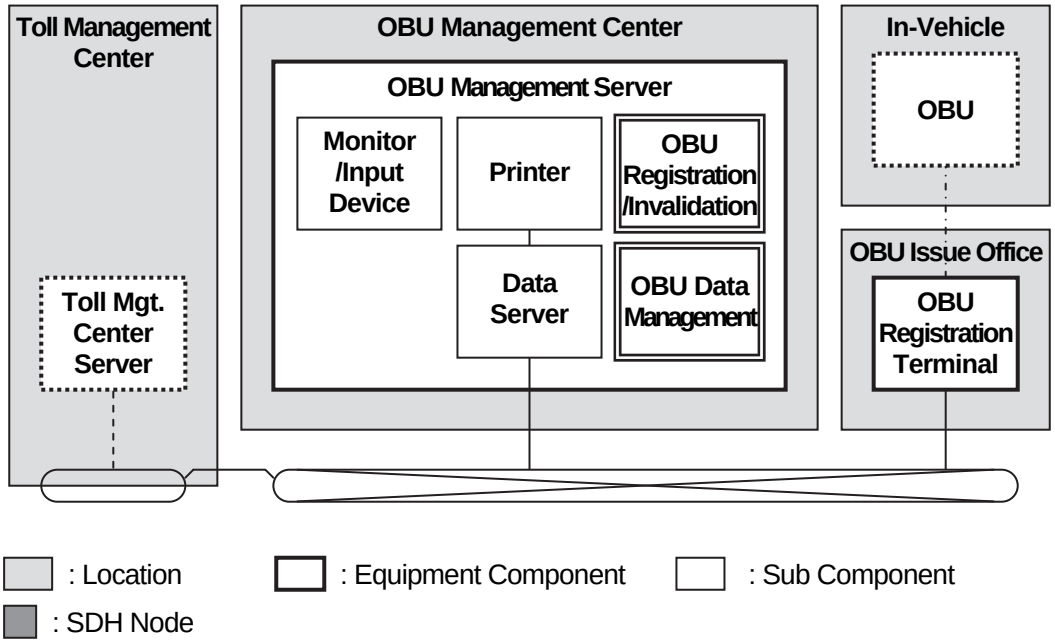
4. Requirements

- 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



Broken Lines: Outside of This Functional Package

6. OBU Registration Terminal

6.1 Functions

- The terminal shall be capable of providing a unique ID for any OBU which is registered any place in the country.
- The terminal 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 terminal 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 terminal shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period and power outage period.

6.2 Structure

- The terminal shall be protected with measures against lightning.
- The chassis of terminal shall not be opened easily, and its door shall have a lock.
- The chassis of terminal shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The terminal shall be protected with measures against interference from other electronic devices.
- The structure of terminal shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the terminal shall be capable to implement the periodical checking and clean-up activities.

6.3 Performance

- The terminal shall have the following performance.
    - Number of CPU Core: Greater or equal 4 core
    - Memory: Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 1 Terabyte
    - Power Consumption: less than 700W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: Tower style
- The terminal shall be capable of requesting the OBU ID issuance to “OBU Management

Server" at the time of initial OBU registration.

- The terminal 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 terminal 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 terminal shall be capable of making encryption of the OBU Registration Data set when it is written into the OBU.
- The terminal shall be capable of communicating between with OBU and OBU Registration Terminal by radio communication or Contactless IC-Card.
- The terminal shall be capable of transmitting the registered OBU Registration Data set, information of the Vehicle and User's information to "OBU Management Server".
- The terminal 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".
- The terminal shall be capable of receiving "OBU Registration Data" sent by "OBU Management Server".
- Recommended size of monitor screen shall be (approx.) 20 inches or over.
- The OBU registration terminal console shall have user-friendly interface.
- The system 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).
- Language on system software shall be capable of being displayed in Vietnamese and English except for the geographic name.

6.4 Human Machine Interface

- The terminal shall have human machine interface for "Operator" to input for retrieve the "OBU Registration Data.
- The terminal shall have equipment such as keyboard and optical mouse.
- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

6.5 Communication Interface

- The terminal shall have the network adapter such as the Ethernet adapter.
- The terminal 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.

6.6 Installation

- The terminal shall be capable of installing on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The installation work shall include equipment component 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 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 lighting protection system and other grounding facilities installed within short distance.

7. OBU Management Server

7.1 Functions

- The server shall be capable of recording the OBU ID which is registered any place in the country.

- The server shall be capable of displaying out the OBU data related to OBU registration.
- The server shall be capable of storing all OBU registration data.
- The server shall be capable of making backup of the stored data.
- The server shall be capable of operating continuously 24 hours a day for 365 days a year, except for maintenance and repair period and power outage period.

7.2 Structure

- The server shall be protected with measures against lightning.
- The chassis of server shall not be opened easily, and its door shall have a lock.
- The chassis of server shall be capable of dissipating temperature rising from inside equipment and radiant solar heat.
- The server shall be protected with measures against interference from other electronic devices.
- The structure of server shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of the server shall be capable to implement the periodical checking and clean-up activities.

7.3 Performance

- The server shall have the following performance;
    - Number of CPU Core: Greater or equal 4 cores
    - Memory：Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 300 Gigabyte
    - Corresponding to the Hot Plug function
    - Power Consumption: less than 800W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: rack mount
- The server (Blade Server) shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).
- The server shall be capable of receiving the registered OBU Registration Data set, information of the Vehicle and User's information from "OBU Registration Terminal".
- The equipment component shall be capable of transmitting the invalidation list of OBU to the Toll Management Servers.

- The server shall be capable of storing the OBU Registration Data set, with information of Vehicle and User's information in the database.
- The server shall be capable of printing and displaying the retrieved information.
- The server shall have storage capacity to store on all OBU data.
- The server shall be capable of executing backup of the stored data in the server on the date which is set up in advance.
- The following backups shall be performed as part of system backup:

  (1) Continuous data protection backup: Backup is to restore HDD of this 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 this Server. Full back up is making a copy of all data in this 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 OBU Management Server.
- The server shall be capable of executing the restoration of backup data.
- The server shall be capable of displaying the retrieved results on the monitor screen by operation PC.
- The server shall be capable of printing information which is displayed on Monitor Screen by operation PC.
- Recommended size of monitor screen shall be (approx.) 20 inches or over.
- All consoles shall have user-friendly interface.
- The server shall be capable of printing retrieved results by A4/A3 type printer.

7.4 Human Machine Interface

- The server shall be capable of management by the remote control from an operation PC.
- The operation PC shall have the following performance.
  - Number of CPU Core: Greater or equal 2 core
  - Memory: Greater or equal 2 Gigabyte
  - Hard Disk Drive: Greater or equal 250 Gigabyte
  - Power Consumption: less than 100W
  - System Inlet Temperature: 10 – 35 °C
  - Relative Humidity: 10 – 90%
  - Type: Space Saving

- The operation PC shall have human machine interface for “Operator” displaying and inputting information.
- The operation PC shall have equipment such as keyboard and optical mouse.

7.5 Communication Interface

- The server shall have the network adapter such as the Ethernet adapter.
- The server 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 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 server shall be capable of installing on the operating system such as Microsoft Windows or Linux which is widely available in many countries.
- The server shall have database system such as Oracle or MySQL or etc.
- The installation work shall include equipment component 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 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 lighting protection system and other grounding facilities installed within short distance.

8. OBU Management Server (OBU Registration/Invalidation)

8.1 Functions

- The system shall be capable of indicating unique OBU ID for checking registered OBU ID.
- The system shall be capable of registering the OBU information from OBU Registration Terminal.
- The system shall be capable of receiving the invalidation data from bank(s), and then the invalidation list shall be transmitted to Toll Management Server.
- The system shall be capable of making the invalidation list.
- The system shall be capable of checking the OBU registration data and invalidation list.

8.2 Performance

- The system shall be capable of transmitting a unique OBU ID for the request of OBU ID issue from “OBU Registration Terminal”.
- 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 absolutely avoid issuing duplication of OBU ID.
- The system shall be capable of retrieving the relevant information from the database.
- Language on system software shall be capable of being displayed in Vietnamese and English except for the geographic name.

8.3 Human Machine Interface

- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

8.4 Communication Interface

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

8.5 Installation

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

9. OBU Management Server (OBU Data management)

9.1 Functions

- The system shall be capable of composing the Invalidation list based on the information recorded in OBU Management Server and the notices such as Lost IC-Card and Suspended IC-Card.
- The system shall be capable of receiving, compiling and manage the OBU registration data.
- The system shall be capable of receiving the related information of enforcements from toll management server.

9.2 Performance

- The system shall be capable of automatically preparing the statistical data related to OBU information, based on the OBU Information data stored in “OBU Management Server”. Necessary statistical data is monthly, daily, and hourly OBU registration data.
- The system shall be capable of automatically updating the transaction data and toll collection data on a real time basis.
- The system shall be capable of compiling statistical data and make reports: daily report, weekly report, monthly report, and yearly report.
- The system shall be capable of displaying the information of OBU registration data and invalidation data into table and chart formats.
- The system 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).
- Language on system software shall be capable of being displayed in Vietnamese and English except for the geographic name.

9.3 Human Machine Interface

- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

9.4 Communication Interface

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

interoperability of devices.

9.5 Installation

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

10. 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: However, if it is defined for each equipments on requirement specification then shall be in accordance with the conditions.

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

11. Power Supply

- The nominal characteristics of the main supply are 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.

12. 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 DRVN, 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 DRVN, and the manufacturer shall provide the necessary services based on the contract.

13. 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.

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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN and the consultant

(4) The necessary number of submission documents

(20)
Axle Load Measurement
(For Reference)

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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

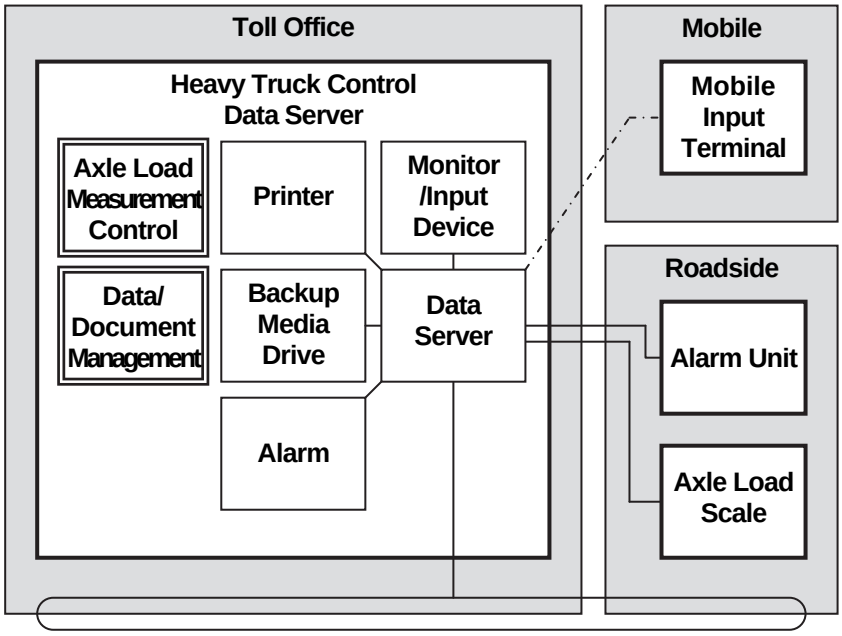
4. Requirements

- System shall be capable of measuring the number of axles and axle loads of vehicles in the high speed range, 10 - 100 km/h.
- System shall be capable of notifying the detection of overloaded vehicle by using Alarm unit, Monitor and Mobile Input Terminal to the operator who monitors the measurement results in the Toll Office and other staff who monitors the measurement result at the road side.
- System shall be capable of generating/storing identification data of overloaded vehicles.
- System shall be capable of controlling the roadside equipment remotely at the Toll Office.
- System shall be capable of synchronizing the measurement result and the image which is the front side of the vehicle includes number plate.
- System shall be capable of displaying and showing the measurement result and the image to the driver for, the evidence of overload at the road side by using Mobile Input Terminal.
- System shall be capable of storing the image which is the front side of the vehicle include number plate, and the measurement result of axle load, in case the overloaded vehicle.
- System shall be capable of minimizing load caused by data transmission, including video image on the communication system.
- System shall be capable of displaying, output the needed data (soft copy) and printing out the needed data, such as the image which is the front side of the vehicle include number plate and the measurement result of axle load.
- System shall be capable of functioning in 24/7 by a redundant system without the maintenance and replacement period.

5. System Architecture

System architecture for Axle Load Measurement is shown below.

Figure 5.1 System Architecture for Axle Load Measurement



: Location : Equipment Component : Sub Component

: 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 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 the 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 operator 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 the 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 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 the 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.
- The Data Server shall have the following performance;
    - Number of CPU Core: Greater or equal 4 cores
    - Memory：Greater or equal 8 Gigabyte
    - Hard Disk Drive: Greater or equal 300 Gigabyte
    - Corresponding to the Hot Plug function
    - Power Consumption: less than 800W
    - System Inlet Temperature: 5 – 35 °C
    - Relative Humidity: 15 – 85%
    - Type: rack mount
- The Data Server (Blade Server) shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).
- The operation PC shall have the following performance.
    - Number of CPU Core: Greater or equal 2 core
    - Memory: Greater or equal 2 Gigabyte
    - Hard Disk Drive: Greater or equal 250 Gigabyte
    - Power Consumption: less than 100W
    - System Inlet Temperature: 10 – 35 °C
    - Relative Humidity: 10 – 90%

- Type: Space Saving

- Printer prints out required information in monochrome in A4 and A3 paper.

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 the 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

- In case that some parts of function required are realized by some pieces of software, the software shall be capable of being installed on the operating system such as Microsoft Windows or Linux which is widely used in many countries of Data Server.
- 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 the 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. Heavy Truck Control Data Server (Axle Load Measurement Control)

8.1 Functions

- The system shall be capable of storing the transmitted measurement data from the axle load scale.

8.2 Performance

- The system shall be capable of automatically assigning serial number into Heavy Truck Control Data Server in corresponding to the storing time of measurement data which is obtained by axle load scale, and image of license plate.
- The system shall be capable of releasing the measurement data after completion, based on the input conditions from traffic inspector.
- The system shall be capable of defining the place of interchanges by road section.
- The system shall be capable of defining the time and date of the measurement by year, month, date, hour, and minute.
- 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 saving the compiled data in CSV format. It shall be capable of being accessed and modified using commercially application software (such as Microsoft Excel).
- Language on system software shall be capable of being displayed in Vietnamese and English except for the geopraphic name.

8.3 Human Machine Interfaces

- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

8.4 Communication Interfaces

- The system shall be capable of transmitting 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.

8.5 Installation

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

9. Heavy Truck Control Data Server (Data/Document Management)

9.1 Functions

- The system shall be capable of receiving, compiling and manage the measurement data.

9.2 Performance

- The system shall be capable of automatically preparing the statistical data related to invalidation information, based on the measurement data stored in “Heavy Truck Control Data Server”. Necessary statistical data is monthly, daily, and hourly OBU registration data.
- 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 automatically updating the measurement data.
- The system shall be capable of compiling statistical data and make reports: daily report, weekly report, monthly report, and yearly report.
- The system shall be capable of displaying the information of invalidation data into table and chart formats.
- The system shall be capable of saving the compiled data in CSV format. It shall be capable of being accessed and modified using commercially

9.3 Human Machine Interfaces

- The screen shall have user-friendly interface.
- The system shall be a screen having high operability. The screen is proposed by the screen specifications which a contractor makes and it shall be approved by the client.

9.4 Communication Interfaces

- The system shall be capable of transmitting 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.

9.5 Installation

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

10. Alarm Unit

10.1 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.

10.2 Structure

- 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.

10.3 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.

10.4 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.

10.5 Communication Interfaces

- Communication interfaces shall be properly selected to function well during data and signal transmission between Heavy Truck Control Data Server and Alerm.

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 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.

11. Mobile Input Terminal

11.1 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.

11.2 Structure

- 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.

11.3 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.

11.4 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.

11.5 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.

12. 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 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.

13. Power Supply

- The nominal characteristics of the main supply are 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.
- 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.

14. 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 DRVN, 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 DRVN. 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 axle load measurement equipment component functions shall be verified before delivery, and the contractor/manufacturer shall deliver with certificate of verification.

16. 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN and the consultant

(4) The necessary number of submission documents

(21)
Measurement Lane Monitoring
(For Reference)

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 the Toll 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: 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)

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

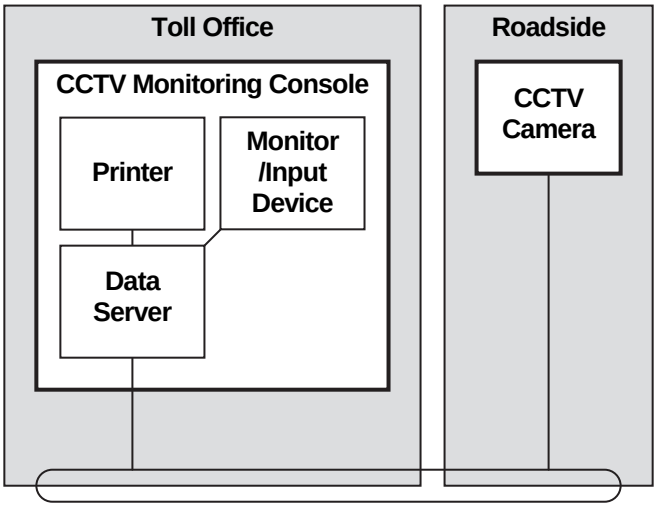
4. Requirements

- System shall be capable of monitoring vehicles passing through a tollgate lane at the Toll Office, and identifying their type such as trailer, semi-trailer, bus and passenger car by visual observation.
- System shall be capable of controlling the roadside equipment remotely at the Toll Office.
- System shall be capable of storing the image which is the front side of the vehicle include number plate, and the measurement result of axle load, in case the overloaded vehicle.
- System shall be capable of minimizing load caused by data transmission, including video image on the communication system.
- System shall be capable of displaying, output the needed data (soft copy) and printing out the needed data, such as the image which is the front side of the vehicle include number plate and the measurement result of axle load.
- System shall be capable of functioning in 24/7 by a redundant system without the maintenance and replacement period.

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 Component : Sub Component
: 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 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.
- 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 equipment to be located at outdoor, the screw for attachment should be antitheft type.
- In case the equipment 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 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 operator on the monitor.

- The size of monitor screen shall be 20 inches or over.
- The system shall allow operator to monitor all displayed images.
- The monitors shall 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 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.
- The CCTV Monitoring Console shall have the following performance.
  - Number of CPU Core: Greater or equal 4 core
  - Memory: Greater or equal 8 Gigabyte
  - Hard Disk Drive: Greater or equal 1 Terabyte
  - Power Consumption: less than 700W
  - System Inlet Temperature: 5 – 35 °C
  - Relative Humidity: 15 – 85%
  - Type: Tower style

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. However, if it is defined for each equipments on requirement specification then shall be in accordance with the conditions.

  For Regional Main Center, Road Management Office, Toll Management Center, and Toll Office

  Temperature: 25 +/- 3 degree Celsius in average

Relative humidity: between 20 and 80 % in average

For outside

Temperature: between - 0 and +50 degree Celsius

Relative humidity: below 95 % in average

- It is recommended that the lighting condition of 200 lx is provided to allow easy operation and maintenance in the Regional Main Center.

9. Power Supply

- The nominal characteristics of the main supply are 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 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 DRVN, 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 DRVN. 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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 DRVN 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 and offices, which comprises fibre optic cables installed in the shoulder or medium strip along the expressways and communication nodes, and access network between communication nodes and roadside equipment components.

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, the Road Management Offices, the Toll Offices, and tollbooths of the expressway network for actualizing functional packages.

3. Relevant Regulations and Standards

- ITU-T X.200, ISO/IEC 7498-1: Information Technology – Open Systems Interconnection – Basic Reference Model: The Basic Model (OSI Reference Model)
- IETF RFC 791: Internet Protocol (IP)
- IETF RFC 793: Transmission Control Protocol (TCP)
- IETF RFC 768: User Datagram Protocol (UDP)
- IETF RFC 854: Telnet Protocol Specification
- IETF RFC 894: A Standard for the Transmission of IP Datagrams over Ethernet Networks (IP over Ethernet)
- IETF RFC 959: File Transfer Protocol (FTP)
- IETF REC 792: Internet Control Message Protocol (ICMP)
- IETF RFC 1058: Routing Information Protocol (RIP) version 1
- IETF RFC 2080: RIPng for IPv6
- IETF RFC 2453: Routing Information Protocol version 2
- IETF RFC 1112 Internet Group Management Protocol (IGMP) version 1
- IETF RFC 2236 Internet Group Management Protocol (IGMP) version 2
- IETF RFC 3376 Internet Group Management Protocol (IGMP) version 3
- IETF RFC 1157: Simple Network Management Protocol (SNMP)
- IETF RFC 1441: Simple Network Management Protocol (SNMP) version 2
- IETF RFC 3411 – 3418: Simple Network Management Protocol (SNMP) version 3
- IETF RFC 2328: Open Shortest Path First (OSPF) version 2
- IETF RFC 5340: Open Shortest Path First (OSPF) version 3
- IETF RFC 2616: Hypertext Transfer Protocol – HTTP/1.1

- IETF RFC 2460: Internet Protocol , Version 6 (IPv6) Specification
- IETF RFC 4335: The Secure Shell (SSH) Session Channel Break Extension
- 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
- 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
- TCVN 8078: 2009 Internet Protocol Gateway (IP Gateway) – Technical Requirements
- TCVN 9385:2012 Protection of structures against lightning – Guide for design, inspection and maintenance

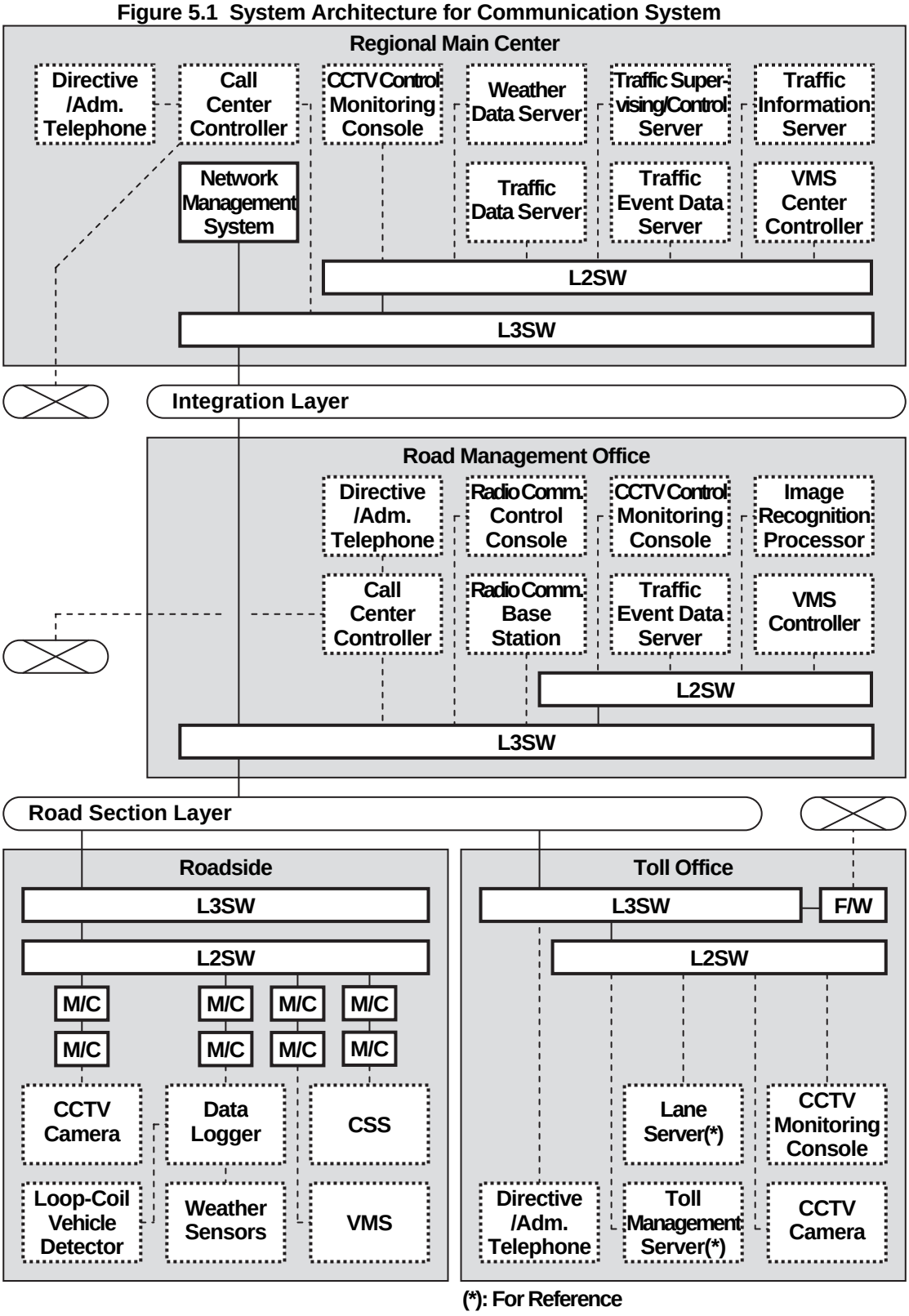
4. Requirements

- System shall be capable of exchanging data among roadside equipment on the expressways, the Regional Main Center and the Road Management Offices.
- System shall be capable of transmitting video images from roadside equipment to the Road Management Office and the Regional Main Center.
- System shall be capable of transmitting interactive voice communications among the Regional Main Center, the Road Management Offices, and the Toll 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 is recommended to deploy for the National Layer Network, which connects between the Regional Main Center, and Integration Layer Network which connects among the Regional Main center and the Road Management Offices.
- System shall be capable of identifying location of fault that occurs on communication network.
- System shall be capable of functioning 24 hours a day, 365 days a year using a redundant system.
- 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.
- The MOT shall be capable of instructing the manager of the system and of disclosing the specifications of the existing system in case there is an associated existing system.

5. System Architecture

System architecture for communication system is shown below.

Figure 5.1 System Architecture for Communication System



(*): For Reference

6 Layer 3 Switch (L3SW)

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 concern the Road Management Office and directive to the specific offices including the 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 operator. 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 country of manufacture.
- Transmitting data through switching equipment component shall be capable of maintaining appropriate security conditions.
- The L3SW shall support the routing protocol of Open Shortest Path First (OSPF).
- The L3SW shall support Simple Network Management Protocol (SNMP) v1/v2/v3.
- The L3SW shall equip the loop detection function.
- The L3SW shall support telnet or SSH remote access.
- The switching function to the redundant L3SW should be equipped automatically when

a failure of the L3SW in operation is detected, and it should be capable to distinguish operation conditions of L3SW such as “Normal” or “Trouble” for both in operation and redundant switches. If it is not switched over to the redundant equipment component, L3SW should be capable to switch over manually on mandatory basis.

6.2 Structure

- The L3SW to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The switching equipment component shall have necessary reliability to fulfil the specified MTBF in the following clause.
- 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 the 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.

- This equipment component's min. MTBF should be 100,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

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.
- When a fault occurs in L3SW, the network management system (NMS) shall be capable to detect it and notify it to the O&M staff by issuing of alert such as buzzer or alert screen on the display of NMS.

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, and voice.

- In future after completion of the project, if the new switch or new roadside equipment component is required to connect to the installed switch, necessary information shall be disclosed to the related parties.

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 the Regional Main Center, the Road Management Offices, the 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 earthing of the lightning protection system and other earthing 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 Layer 2 Switch

7.1 Functions

- The switching equipment component shall be capable to switch required ITS related communication traffic.
- The switching equipment component shall comply with international standards.
- The switching equipment components shall have compatibility of interfaces for connection with the transmission equipment components.
- The fault of the switching equipment component shall be capable to be detected and capable to be notified to the operator.
- Transmitting data through switching equipment component shall be capable of maintaining appropriate security conditions.
- The switching equipment component shall have been accepted by road operators, communication carriers or operators in the countries of manufacture.
- The L2SW shall support telnet or SSH remote access.
- IP address shall be capable to allocate for L2SW at least one so as to identify L2SW with network management system.

7.2 Structure

- The L2SW to be procured in the project shall be new and unused. Any equipment

containing defects or imperfection shall not be acceptable.

- The switching equipment component shall have necessary reliability to fulfil the specified MTBF in the following clause.
- 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.

7.3 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 data and video image transmission quality shall comply with the conditions of Class 4 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 except for the maintenance and equipment replacement time.
- This equipment component's min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

7.4 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.
- When a fault occurs in L2SW, the network management system (NMS) shall be capable to detect it and notify it to the O&M staff by issuing of alert such as buzzer or alert screen on the display of NMS.

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 and data.

- In future after completion of the project, if the new switch or new roadside equipment component is required to connect to the installed switch, necessary information shall be disclosed to the related parties.

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 Switching Equipment Components shall be installed in an air conditioned room, in the Regional Main Center, the Road Management Offices, the 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 earthing of the lightning protection system and other earthing 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. Media Converter (M/C)

8.1 Functions

- The Media Converter (M/C) shall be capable to transmit all ITS related communication traffic between L2SW and roadside equipment component.
- The M/C shall be capable of converting electric signal which is transmittable through copper cable to optical signal which is transmittable through optical fiber cable and vice versa.
- The M/C shall be complied with the international standard.
- In between L3SW and another L3SW and L3SW and L2SW, Small Form-Factor Pluggable (SFP) transceiver module should be applied. The SFP transceiver module should be considered as a component of switch.
- The M/C functions shall be confirmed by road operators, communication carriers or operators in foreign countries excluding the country of manufacture.

8.2 Structure

- The M/C to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The M/C shall be capable of operating continuously 24 hours a day for 365 days a year.
- The M/C shall be able to be fixed in the chassis.
- The M/C shall allow replacement of the faulty component simply and easily when a fault is detected.
- The M/C shall allow implementing periodic checking and clean up activities.

8.3 Performance

- The M/C shall transmit the required communication traffic in appropriate timing under the conditions stipulated in the concerned sections of these specifications.
- The data and video image transmission shall comply with the conditions of Class 4 of ITU-T Recommendation Y.1541 within the communication network of ITS.
- The M/C shall be capable of operating continuously 24 hours a day for 365 days a year except for the maintenance and equipment replacement time.
- This equipment component's min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

8.4 Human Machine Interfaces

- When a fault occurs in M/C, the network management system (NMS) should be capable to detect it as a fault, and notify it to the O&M staff by issuing of alert such as buzzer or alert screen on the display of NMS.

8.5 Communication Interfaces

- The communication interfaces of the M/C shall comply with international standards.
- The communication interfaces of the M/C shall not be hindrance of transmission of moving image and data.

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.
- If the M/C 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 earthing of lightning protection system and other earthing 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 Firewall

9.1 Functions

- The firewall shall be capable of controlling communication between the Internet and intranet.
- The firewall shall be capable of setting the control that followed security policy.

9.2 Structure

- The firewall to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The firewall shall be capable of operating continuously 24 hours a day for 365 days a year.
- The firewall shall be able to be fixed in the chassis.
- The firewall shall allow replacement of the faulty component simply and easily when a fault is detected.
- The firewall shall allow implementing periodic checking and clean-up activities.

9.3 Performance

- The firewall shall be capable of deciding the transit of the packet according to a defined filtering rule.
- The firewall shall be capable of monitoring and memorizing a status and a flow of the communication. And it shall be capable of controlling network access by opening only a session of admitted application.
- The firewall shall be capable of recognizing contents to applications level above the IP layer. And it shall be capable of defending falsification and the attack of data.
- When an attack is detected, the firewall shall be capable notifying an operator.
- The firewall shall be capable of outputting conditions of the communication as log.
- The firewall shall be capable of translating a specific private address into a global address for identification.
- This equipment component's min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

9.4 Human Machine Interface

- When a fault occurs in firewall, the network management system (NMS) should be capable to detect it as a fault, and notify it to the O&M staff by issuing of alert such as buzzer or alert screen on the display of NMS.

9.5 Communication Interfaces

- The communication interfaces of the firewall shall comply with international standards.

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.
- If the firewall 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 earthing of lightning protection system and other earthing 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. Optical Fiber Cable

10.1 Functions

- Optical Fiber Cable is applied for ITS communication network basically whose distance exceeds transmittable distance of copper 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 operator.
- 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 country of manufacture.

10.2 Structure

- The optical fiber cable to be procured in the project shall be new and unused. Any cable containing defects or imperfection shall not be acceptable.
- The optical fiber cable shall be installed in ducts basically.
- The optical fiber cable to be applied in this project shall have sufficient capability to resist against rodent attack.

10.3 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 comply 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 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 operator 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 outsourced to other organization, such necessary conditions shall be specified in the outsourcing contract documents.

10.4 Human Machine Interfaces

- When a fault is detected by network management system (NMS), it should be notified to the O&M operator by the alert function such as by buzzer or alert screen on the display of NMS.
- When a fault is identified as the optical fiber cable's fault, the maintenance staff should identify the fault location by using the measuring instrument, such as Optical Time Domain Reflectometer (OTDR). When maintenance staff uses the measuring instrument, the proper size display to show the measurement result shall be equipped.

10.5 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 and voice.

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 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 switches to be located in the Regional Main Center, the Road Management Offices, Terminal Nodes, and the Toll Offices where the physical network connection is required. In addition, it shall be also installed in between Media Converters to be located close to the roadside equipment components.
- 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 earthing of lightning protection system and other earthing 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 Network Management System (NMS)

11.1 General Outline

The Network Management System (NMS) to be located in the 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 the Regional Main Center shall be capable to monitor Integration Layer Network under the Regional Main Center.

All network equipment components and roadside equipment components which is capable to allocate IP address shall be capable to be monitored by at least one of the above NMS.

11.2 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, and 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 operator by buzzer or alert screen of display is also required.

(2) Resource Management Function

Function of monitoring operation condition of L3SW, L2SW, roadside equipment which is connected to the network is required. When system configuration is modified, the function of adding, 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 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. If this function is realized by L3SW, it is acceptable.

11.3 Structure

- The NMS to be procured in the project shall be new and unused. Any equipment

containing defects or imperfection shall not be acceptable.

- The NMS shall have necessary reliability or 24 hours 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.

11.4 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, and roadside equipment components.
- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year.
- This equipment component's min. MTBF should be 50,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

11.5 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 alert screen on display to the O&M staff.

11.6 Communication Interface

- The communication interfaces of NMS shall be complied with the international standard

11.7 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.
- The 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 software shall be installed in a PC to be installed in the Regional Main Center and each Road Management Office.
- 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 earthing of lightning protection system and other earthing 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.

12 IPv4/IPv6 Translator

12.1 Functions

- The IPv4/IPv6 Translator shall be capable to translate the data transmission from IPv4 compatible equipment component to IPv6 only network and vice versa.
- The IPv4/IPv6 Translator shall comply with the international standard.
- The IPv4/IPv6 Translator shall be capable of controlling Quality of Service for all ITS communication traffic basically.
- The fault of the IPv4/IPv6 Translator shall be capable to be detected and capable to be notified to the operator. During emergency repair time after detection of the system fault, continuous operation shall be secured with minimal interruption with the redundant equipment component.
- The IPv4/IPv6 Translator shall have been accepted by road operators, communication carriers or operators in the countries other than the country of manufacture.

12.2 Structure

- The IPv4/IPv6 Translator to be procured in the project shall be new and unused. Any equipment containing defects or imperfection shall not be acceptable.
- The IPv4/IPv6 Translator shall have necessary reliability to fulfil the specified MTBF in the following clause.
- The IPv4/IPv6 Translator shall have a design which is possible to fix in the building, housing or cabinet.
- Faulty parts of the IPv4/IPv6 Translator shall be replaceable simply and easily when fault is detected.
- The IPv4/IPv6 Translator shall be capable of implementing periodic checking and clean-up activities.

12.3 Performance

- The performance of the IPv4/IPv6 Translator shall be guaranteed to translate the required communication traffic in appropriate timing within the requirements stipulated in the concerned sections of the specifications or ITU-T Y1541 class 0 for voice communication and class 4 for data and moving image.
- During maintenance and repair period, the operation shall be continued with redundant components.
- This equipment component's min. MTBF should be 30,000 hours. If the part(s) of the equipment can be replaced easily, it should be excluded from the above MTBF value.

12.4 Human Machine Interface

- The IPv4/IPv6 Translator shall have human-machine interface so that the operation and maintenance staff can make diagnosis of the IPv4/IPv6 Translator, input necessary commands, and execute necessary operation and maintenance activities.
- When a fault occurs in IPv4/IPv6 Translator, the network management system (NMS) shall be capable to detect it and notify it to the O&M staff by issuing of alert such as buzzer or alert screen on the display of NMS.

12.5 Communication Interfaces

- The communication interfaces of the IPv4/IPv6 Translator shall comply with international standards.
- The communication interfaces of the IPv4/IPv6 Translator shall not be hindrance of transmission of moving image, data and voice.

- In future after completion of the project, if the new roadside equipment component is required to connect to the installed equipment component, necessary information shall be disclosed to the related parties.

12.6 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 IPv4/IPv6 Translator shall be installed in an air conditioned room.
- 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 earthing of the lightning protection system and other earthing the security/safeguard system to restrict unauthorized people from entering into the job site shall be provided during installation work.

13. Ambient Conditions

- The equipment component shall be protected against interferences of other electronic devices and electromagnetic noises at the Project site.
- The switches, M/C 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, M/C 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.

14. Power Supply

- The nominal characteristics of the main supply are 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.
- 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.

15. Maintainability

- The equipment components shall be capable of being maintained easily and simply.
- The switches, M/C, IPv4/IPv6 Translator 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, M/C, optical fiber cables, IPv4/IPv6 Translator and NMS shall be available at least five (5) years after the equipment components are handed over to the DRVN, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of switches, M/C, optical fiber cable, IPv4/IPv6 Translator 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, M/C, optical fiber cable, IPv4/IPv6 Translator and NMS is recommended to make a contract for technical support of operation and maintenance related to the delivered equipment components with the DRVN, and the manufacturer should provide necessary services based on the contract.

16. 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 submit a copy of the ISO9001 authentication document as a part of the tender or prequalification proposal.

17. Testing/Inspection

1) General

The Test and Inspection for switches, M/C, 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 DRVN 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. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory test. Copies of them shall be submitted to the DRVN and the consultant for approval.

(3) There are also three types of inspections similar to the tests; the factory inspection and the connection inspection are recommended to be witnessed. However, in case that contractor adopts products distributed in general market, product guarantee certificates are accepted as the substitute for factory inspection same as factory test.

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

(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 DRVN 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 DRVN and the consultant.

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

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

(5) After approval of the unit test procedure, the unit tests shall be executed at site, the Regional Main Center and the Road Management Offices and the test result shall be submitted to the DRVN and the consultant.

(6) The test and inspection procedure of the connection test including roadside equipment components and servers shall be submitted to the DRVN and the consultant.

(7) After approval of the connection test procedure, the contractor will perform its own connection test and the test result shall be submitted to the DRVN and the consultant.

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

(9) Prior to handover, the DRVN, PMU3, responsible organization of O&M of the equipment components, the consultant and the related party will inspect all equipment components at roadside, the Regional Main Center and the Road Management Offices in order to verify the quantity of the equipment components with the contract conditions. The Contractor shall show each equipment component at site and shall bear the necessary cost of this inspection.

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the DRVN 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

The following conditions shall be as per the related clauses of the contract conditions;

(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 DRVN and the consultant

(4) The necessary number of submission of 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 PMU3 and the consultant for approval before commencement of the work. The Construction plan shall be prepared based on “National technical regulation on cable duct and cable jointing chamber” 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. The underground duct to be newly constructed shall be composed of High Density Poly-ethylene (HDPE) pipes in principal. Ducts shall be connected to the chamber.

Types of Chamber listed below shall be applied.

* Type M1 (Inside dimension: 2000x1040x1300 or 1550):

This chamber is for installing cable for keeping them slack. Regular interval is approximately 333 m.

* Type M2 (Inside dimension: 2000x1040x1300 or 1550):

This chamber connects the ducts from earthwork section to the bridge. It is set behind abutment.

* Type M3 (Inside dimension: 2000x1040x1300 or 1550):

This chamber is for installing and connecting cables and keep spare length in the chamber. Regular interval is approximately 2.0 km.

* Type M4 (Inside dimension: 2000x1040x1300 or 1550):

This chamber is set at changing point of cable direction both horizontally and vertically.

* Type M1-S (Inside dimension: 1270x600x1300):

This chamber is for installing cable if the medium strip width is not enough.

* Type E1 (Inside dimension: 600x600x1300 or 1550):

This chamber is for installing power supply cable.

Chamber type shall be selected appropriately. The contractor shall make arrangement plan for chambers and submit to PMU3 and the consultant

(3) Cable Rack and Cable Brackets

Cable Rack and Cable Brackets in the Chamber shall be as per the related drawings and Vietnamese standard.

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 PMU3's approval.

3 The Contractor shall obtain permission for the excavation and site occupancy form proper authorities. The contractor shall provide the necessary drawing and document to the Authority. PMU3 should cooperate with the authorities in order to obtain the permission for the Contractor.

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, PMU3 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 PMU3's approval.

7 PMU3 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 the 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 complied 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 a record.

(2) Chamber

1 Chamber shall equip with covers and frames, duct plug, cable racks, cable brackets, name plates and sump pit.

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.

PMU3 may require the slump test for every batch of the concrete.

d. PMU3 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 90 minutes or as per the Vietnamese standard. After that time, 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.

10. If the existing chamber is buried under the current ground level and it is required to use that chamber for cable installation, cover level adjustment work to the current surface level should be made. The contractor shall submit the detailed drawing of this work for approval of the consultant, PMU3 and VEA.

(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 PMU3 and the consultant and subject to the approval and acceptance of PMU3.

2 The Contractor shall obtain permission for the excavation and site occupancy from proper authorities. The contractor shall provide the necessary drawing and/or data to the authority. Permission shall include property owners' approvals for necessary work on their properties. PMU3 should cooperate with the authorities in order to obtain the permission for the Contractor.

3 The contractor shall obtain all pertinent records from the Electric Power Supply, Water Supply, and Sewer Authority and other organizations for underground utilities in order to proceed with 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 facilities for existing ITS related cables 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 PMU3 and the consultant 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 PMU3 and the consultant 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 PMU3 and the consultant and other relevant authority to ensure about the proposed depth of Chamber to the final grades and level of medium strip or shoulder of carriage-ways.

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 existing ITS related facility 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 PMU3 and the owners of such plants.

12 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 PMU3 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 PMU3 and the consultant.

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 PMU3 and the consultant'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 of carriage way…….. 70 cm or more

However, in special case, the depth shall be determined in consultation with PMU3 ~~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 of carriage way.

(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 PMU3. The bottom of trench shall be flattened after removing stones and other protrusion.

The bedding of 10 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 PMU3 and the consultant.

(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 bind to the cable bearer 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 PMU3 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 excavated trench.

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 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 Necessary Procedure related to the Construction Work

1) Necessary Procedure Prior to Commencement of the installation work

Prior to commencement of the installation work, the Contractor shall fulfil the following conditions at least but not limited to the followings;

(1) The detailed implementation schedule shall be submitted to the consultant, PMU3, and VEA for approval.

(2) The construction drawing shall be prepared and approved by the consultant, PMU3 and VEA and other authorities if necessary. The quantity of the construction work and equipment to be installed shall be clearly described in the drawing. Bill of quantities shall be also prepared.

(3) The organization chart of the contractor including subcontractors with its work demarcation shall be submitted to the consultant, PMU3 and VEA for approval.

(4) The key person's curriculum vitae of the contractor shall be submitted to the consultant, PMU3 and VEA for approval.

(5) The subcontractor's company profile, organization chart, similar project experiences, assigned person's curriculum vitae shall be submitted to the consultant, PMU3 and VEA for approval.

(6) Construction material specifications and testing method shall be submitted to the consultant, PMU3 and VEA for approval. The laboratory information to perform the material test shall be included in the testing method.

(7) The document describing construction method shall be submitted, and approved by the Consultant, PMU3 and VEA.

(8) The document describing traffic safety shall be submitted, and approved by the consultant, PMU3 and VEA.

(9) The approved construction drawings, documents on construction method and traffic safety shall be submitted to the road management authority for each road section respectively through PMU3, and the contractor needs to obtain the construction license from all of the authorities prior to commencement of the construction work.

(10) The contractor shall collect the sample of materials to be applied in this project which should be inspected by the consultant, PMU3 and VEA.

(11) The contractor shall submit the material test result to the consultant, PMU3 and VEA for approval prior to commencement of the construction work. The contractor shall submit the request letter for inspection of the laboratory test to the consultant, PMU3 and VEA before laboratory test.

(12) Prior to commencement of installation work, the contractor shall submit the inspection procedure and inspection forms to be applied for the necessary steps of the construction work for approval of the consultant, PMU3 and VEA. The form is composed of quality inspection and quantity inspection. The inspection shall be

witnessed by the consultant, PMU3 and VEA basically.

(13) All of the drawings and documents mentioned above shall be prepared in English and Vietnamese.

2) Necessary Procedure during installation work

(1) During installation work, the contractor shall submit the “Request for Inspection” at least 2 days prior to commencement of the inspection using approved inspection form.

(2) The Inspection shall be made in accordance with the approved form witnessed by the consultant, PMU3 and VEA.

(3) All of the documents mentioned above shall be prepared in English and Vietnamese.

3) Necessary Procedure prior to Handover

(1) The contractor shall prepare the as built drawing and approved by the consultant.

(2) Prior to the hand over meeting, joint inspection for roadside equipment component and equipment installed in the Road Management Office or the Regional Main Center is required. The participants of this inspection are the recipient of the equipment/system, PMU3, VEA, the consultant, and the contractor.

(3) The contractor shall prepare the hand over document for each road authority before hand over meeting.

(4) All of the documents mentioned above shall be prepared in English and Vietnamese separately.

1.4 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 PMU3, VEA and 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 the consultant, PMU3 and VEA.

(2) Chamber

1 The following test shall be carried out in the presence of PMU3, VEA 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 test 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 to the original condition for the excavated part 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

Criteria		Test Method
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 approved by the consultant, PMU3 and VEA.

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 the consultant, PMU3 and VEA 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:

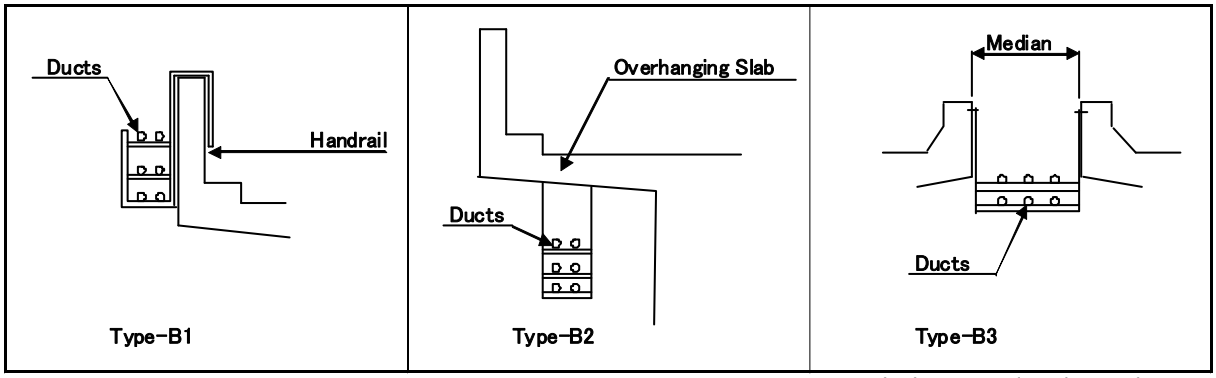
1. Communication Duct Layout
2. Section Drawings (including details of supporting structure of duct)
3. Details of Camber

(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. The location where direct sun shine is expected, the HDPE should be weatherproof type.
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 (Dimension: 1600x675x675): 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 approval of the consultant, PMU3 and VEA.

3 PMU3 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 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, PMU3 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 PMU3's approval.

7 PMU3, VEA 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 the consultant, PMU3 and VEA. The contractor shall not proceed with any welding until the consultant, PMU3 and VEA 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 the consultant, PMU3 and VEA. 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 the consultant, PMU3 and VEA.

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 the consultant, PMU3 and VEA.

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 confirmation of the consultant, PMU3 and VEA for 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 the consultant, PMU3 and VEA.

(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 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 Necessary Procedure related to the Construction Work

1) Necessary Procedure Prior to Commencement of the installation work

Prior to commencement of the installation work, the Contractor shall fulfil the following conditions at least but not limited to the followings;

(1) The detailed implementation schedule shall be submitted to the consultant, PMU3, and VEA for approval.

(2) The construction drawing shall be prepared and approved by the consultant, PMU3 and VEA and other authorities if necessary. The quantity of the construction work and equipment to be installed shall be clearly described in the drawing. Bill of quantities shall be also prepared.

(3) The organization chart of the contractor including subcontractors with its work demarcation shall be submitted to the consultant, PMU3 and VEA for approval.

(4) The key person's curriculum vitae of the contractor shall be submitted to the consultant, PMU3 and VEA for approval.

(5) The subcontractor's company profile, organization chart, similar project experiences, assigned person's curriculum vitae shall be submitted to the consultant, PMU3 and VEA for approval.

(6) Construction material specifications and testing method shall be submitted to the consultant, PMU3 and VEA for approval. The laboratory information to perform the material test shall be included in the testing method.

(7) The document describing construction method shall be submitted, and approved by the Consultant, PMU3 and VEA.

(8) The document describing traffic safety shall be submitted, and approved by the consultant, PMU3 and VEA.

(9) The approved construction drawings, documents on construction method and traffic safety shall be submitted to the road management authority for each road section respectively through PMU3, and the contractor needs to obtain the construction license from all of the authorities prior to commencement of the construction work.

(10) The contractor shall collect the sample of materials to be applied in this project which should be inspected by the consultant, PMU3 and VEA.

(11) The contractor shall submit the material test result to the consultant, PMU3 and VEA for approval prior to commencement of the construction work. The contractor shall submit the request letter for inspection of the laboratory test to the consultant, PMU3 and VEA before laboratory test.

(12) Prior to commencement of installation work, the contractor shall submit the inspection procedure and inspection forms to be applied for the necessary steps of the construction work for approval of the consultant, PMU3 and VEA. The form is composed of quality inspection and quantity inspection. The inspection shall be witnessed by the consultant, PMU3 and VEA basically.

(13) All of the drawings and documents mentioned above shall be prepared in English and Vietnamese.

2) Necessary Procedure during installation work

(1) During installation work, the contractor shall submit the “Request for Inspection” at least 2 days prior to commencement of the inspection using approved inspection form.

(2) The Inspection shall be made in accordance with the approved form witnessed by the consultant, PMU3 and VEA.

(3) All of the documents mentioned above shall be prepared in English and Vietnamese.

3) Necessary Procedure prior to Handover

(1) The contractor shall prepare the as built drawing and approved by the consultant.

(2) Prior to the hand over meeting, joint inspection for roadside equipment component and equipment installed in the Road Management Office or the Regional Main Center is required. The participants of this inspection are the recipient of the equipment/system, PMU3, VEA, the consultant, and the contractor.

(3) The contractor shall prepare the hand over document for each road authority before hand over meeting.

(4) All of the documents mentioned above shall be prepared in English and Vietnamese separately.

3.4 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 the consultant, PMU3 and VEA.

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 the consultant, PMU3 and VEA.

(2) Steel structure

1 The following test shall be carried out in the presence of the consultant, PMU3 and VEA.

* Materials

* Welding

(3) Chamber

1 The following test shall be carried out in the presence of the consultant, PMU3 and VEA:

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.

4. Material Specification for Duct and Chamber in bridge sections

4.1 HDPE Pipe

Same as section 2.1.

The duct to be installed at the direct sun shine is expected shall be weatherproof type such as containing carbon black.

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 400 N/mm2

2 Yield Point at Minimum 250 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 approved by the consultant, PMU3 and VEA.

(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. In addition, the contractor shall carry out the geotechnical surveys required for design of each foundation.

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

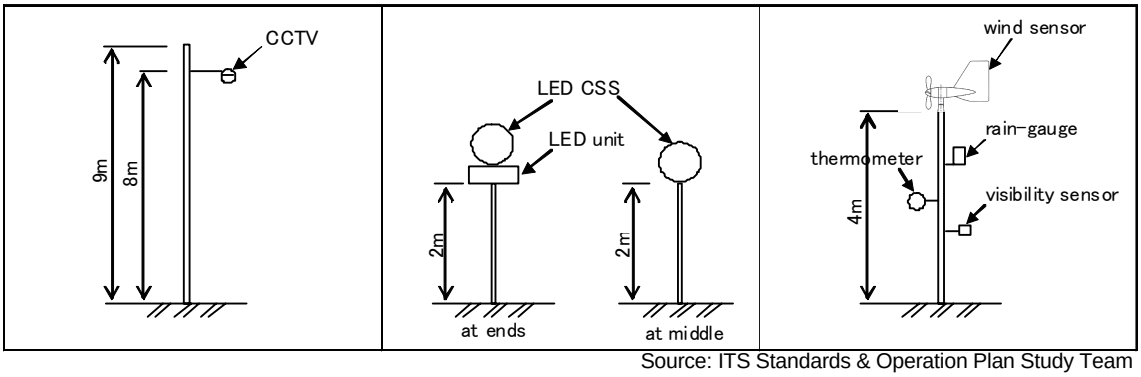
In order to install Changeable Speed Limit Sign, two types of poles should be adopted as shown in Figure 24.1 centre. One is for installing at the ends of an expressway; one is at middle of an expressway.

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

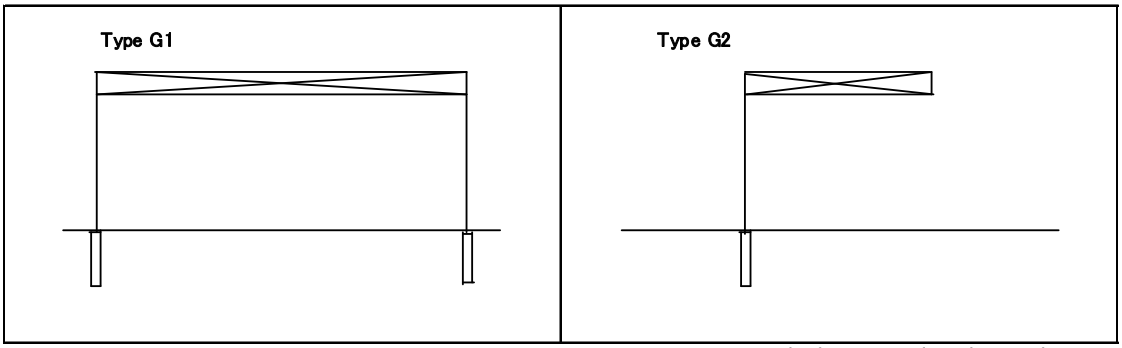
VMSs are designed to set on an earthwork section and a bridge section. Because gantries for VMS did not consider in dead loads when existing bridges were designed, gantries for VMS set on a bridge section should be installed at ground level as an independent structure.

Two groups of gantries for VMS mentioned above, are shown in Figures 24.2 and 24.3 respectively.

Gantry for VMS set on Earthwork section	G1 : Standard frame type
	G2 : Cantilever type
Gantry for VMS set on Bridge section	G3 : Special type on bridge on Ha Noi Ring Road 3

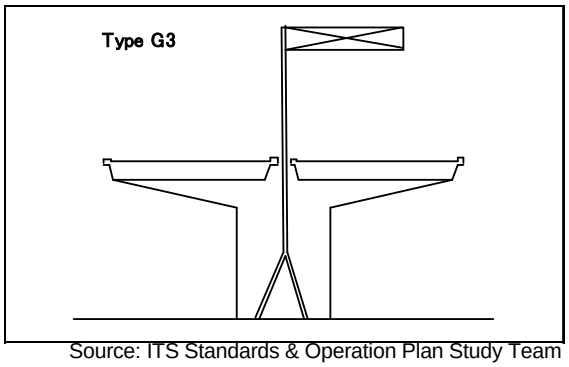
The pole of G3 must be widen near the ground to reduce the deflection that is caused by cantilever-beam and it is height.

Figure 24.2 Gantry for VMS in earthwork area



Source: ITS Standards & Operation Plan Study Team

Figure 24.3 Gantry for VMS on bridge

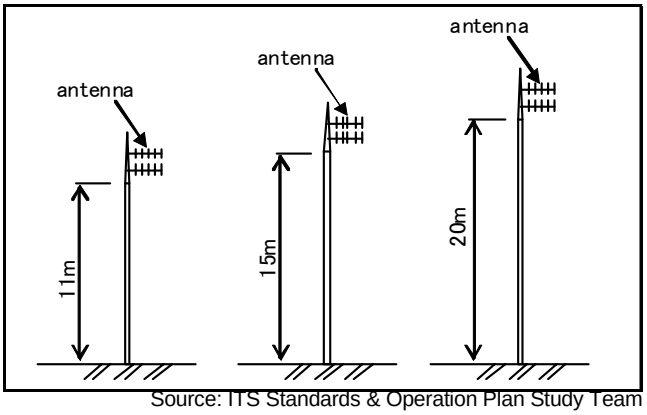


Source: ITS Standards & Operation Plan Study Team

(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.

8 The Contractor shall carry out loading test when some structures are installed on embankment section, if necessary.

(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

(25)
Operation & Maintenance Vehicle

1. Patrol Vehicle

1.1 General Outline

These specifications set forth the general, functional, and technical requirements for the vehicle to be used for traffic management on the expressway.

Patrol vehicle will be used to patrol on the expressway to locate damage, to implement countermeasures such as expressway closure or lane closure, and to undertake emergency action such as removing obstacle on the expressway. As such, the vehicle shall have high driving performance, short stopping distance, high safety features, large loading capacity and environmentally friendly features.

1.2 Composition and performance

- Type : Station wagon type with enclosed cabin, four or more doors, and power steering on the left hand side
- Wheel : Front: 2, Rear: 2
- Overall length : Not more than 6,000 mm
- Overall width : Not more than 1,900 mm
- Overall height : between 1,500mm – 1,950mm approximately
- Engine type : Gasoline engine
- Engine displacement : Not less than 1,400 cc
- Minimum turning radius : 6 meters or less
- Cruising speed : More than 100 km/h
- Torque weight ratio : Not more than 10.5 kg/ N/m when calculated by (body weight + 450kg)/maximum torque
- Braking system : Anti-lock braking system (ABS)
- Other safety features : Side door beam to be provided, Laminated glass (front), Tempered glass (side and rear)
- Number of passengers : 4 passengers or more, include driver
- Alternator and battery of the vehicle, the alternator and battery system shall have the sufficient capacity to provide power to the signboard and warning light (DC 12V 26A) when vehicle is not moving and the engine is idling with throttle level used.

1.3 Warning light

These specifications set forth the general, functional and technical requirements for the vehicle to be used for traffic management on the expressway.

- Length : 1,100 – 1,200

- Colour : Yellow
- Rated voltage : 12
- LED warning light – Flashing : Approx. 160/min more
- LED warning light – Bulb : LED light
- LED warning light – Quantity : 16
- Quantity of speaker : Maximum 1 unit

1.4 Accessories

- Auxiliary head light : 2 units
- Rear window wiper : 1 set
- Rear window glass heater : 1 set
- High-mount brake light : 1 set
- Side mirror : 1 set
- Floor mat : 1 set
- Buzzer for back-up : 1 set
- Air conditioner : 1 set
- AM/FM radio : 1 set
- Clock : 1 set
- Towing rope with hook : 1 set
- Throttle lever : 1 set
- Personal lamp : 1 unit

1.5 Supplies

- Arrow symbol signboard : 3 set, Collapsible signboard with high brightness LED Size 400-500 mm x 700-900 mm
- Safety cone : 6 unit, Height : 700 mm, Weight : approx.. 3 kg
- Flag : 2 set, Size : approx.. 1150 x 900mm, red or orange colour
- Handheld guide sign with LED : 2 set, length : approx.. 500 mm

2. Towing Vehicle

2.1 General Outline

These specifications set forth the general, functional, and technical requirements for the vehicle to be used for traffic management on the expressway.

Towing vehicle has equipment moving a vehicle disturbing the road traffic such as an accident vehicle and a broken-down vehicle. And the towing vehicle used to tow those vehicles on an expressway. As such, the vehicle shall have high driving performance, short stopping distance, high safety features, large loading capacity and environmentally friendly features.

2.2 Composition and performance

- Type : 2 ton class truck with a cargo
- Overall length : Not more than 8,000 mm
- Overall width : Not more than 2,400 mm
- Overall height : Not more than 3,750 mm
- Kerb weight : Not less than 3000 kg
- Engine type : Diesel engine, 4 cycle
- Engine displacement : Not less than 175 kw
- Emission level : Euro-2 or Euro-3
- Number of passengers : 3 passengers or more, include driver

2.3 Crane

- Crane Capacity : Maximum approx.. 3t at 2.5m
- Boom Retracted length : Not greater than 4.0 m
- Boom Extended length : Not less than 7.0m