MINISTRY OF TRANSPORT, VIETNAM

STUDY FOR SUPPORTING ITS STANDARDS & OPERATION PLAN DEVELOPMENT IN VIETNAM

APPENDIX 2

January 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.
NEXCO EAST ENGINEERING CO., LTD.
ALMEC CORPORATION

EID
JR
11-012

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APPENDIX 2:
DRAFT GENERAL SPECIFICATIONS

The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components, which organized by 21 volumes corresponding to the functional packages below.

(1) Telephone Exchange
(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) Lane Monitoring
(13) Vehicle Identification
(14) Lane Control
(15) Road-to-Vehicle Communication
(16) IC-Card Recording
(17) Toll Management
(18) OBU Management
(19) Axle Load Measurement
(20) Overloading Management
(21) Center/Roadside Communication (Including Ducts)

DRAFT GENERAL SPECIFICATIONS (1)

Telephone Exchange

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

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1. General Outlines

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

2. Scope

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

3. Relevant Regulations and Standards

- ITU-T G. 107: The E-Model, a computational model for use in transmission planning
- ITU-T G. 114: One-way transmission time
- ITU-T Y. 1541: Network performance objectives for IP-based services
- ITU-T H.320: Standards for video conferencing
- ITU-T H323: Visual telephone systems and equipment for local area networks which provide a non-guaranteed quality of service
- BS 7430: Earthing
- BS 6651: Lightning Protection

4. Definitions of Terms

- **Incident:** An unusual and unplanned event that affects or impedes the normal flow of traffic, such as traffic accidents, broken-down vehicles, left obstacles, reversing vehicles, vandalism and natural disaster on the road.
- **Main Center:** The Center in charge of traffic monitoring, traffic control and traffic information dissemination, and is to be cooperated with road management offices.
- **Road Management Office:** An office in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring equipment for surveillance.
- **Toll Office:** A toll office is located at a tollgate, which includes two or more tollbooths, and is in charge of toll collection.
- **Draft General Specifications:** The Draft General Specifications defines required

processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.

- **System Architecture1:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Telephone Exchange:** This functional package allows to send an emergency call and a request for help to the Main Centers and road management offices at an incident occurrence by telephones installed at roadsides, rest areas and tunnel sections and by administrative telephones installed at the toll offices, and allows to send directives to the units concerned at an instant for clearing incidents and enforcing traffic regulations.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **ITU:** The International Telecommunication Union is an agency of the United Nations which regulates information and communication technology issues. ITU coordinates the shared global use of the radio spectrum, promotes international cooperation in assigning satellite orbits, works to improve telecommunication infrastructure in the developing world and establishes worldwide standards.

5. Requirements

- System shall be capable of receiving notification of incident occurrence promptly from road user and of identifying the user's location on the expressway.

- System shall be capable of receiving report of current traffic conditions on the expressways and of incident occure promptly from the operators in the toll management office and the rest area.

- System shall be capable of switching and connecting the interactive voice and emergency directives among Main Center, road management offices and toll management offices.

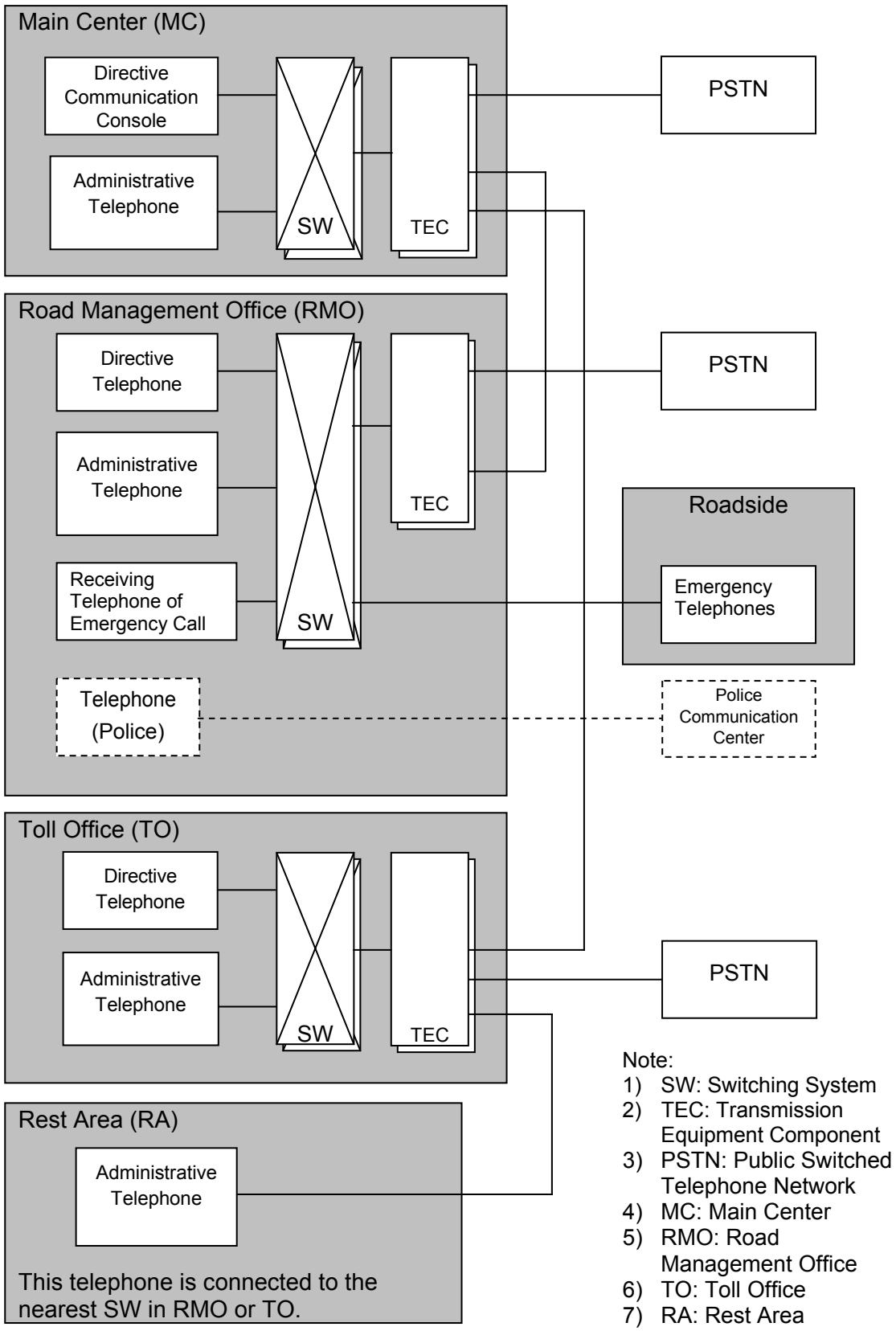
- System shall be capable of sending directives to the units concerned simultaneously and on a top-priority at any time for clearing incidents and enforcing traffic regulations.

- System shall be capable of receiving notification of incident occurrence generally within 20 minutes, and sending road operation vehicles to the incident site generally within 1 hour.

- System shall be capable of functioning 24 hours a day, 365 days a year by a redundant system and sufficient durability/reliability of equipment components.

- In case, part or whole of procurement and operation & maintenance related to the Telephone Exchange is to be outsourced to another organization such as telecommunications carrier or operator, it should be outsourced based on the mutually agreed document such as a contract with making clear system demarcation points and responsibilities of each party.

6. System Architecture



Note:
1) SW: Switching System
2) TEC: Transmission Equipment Component
3) PSTN: Public Switched Telephone Network
4) MC: Main Center
5) RMO: Road Management Office
6) TO: Toll Office
7) RA: Rest Area

7. Telephone Switching Equipment Component

7.1 Functions

- Switching equipment component for directive communication and administrative telephone shall be divided into different units. The emergency telephone is able to connect to the unit for administrative telephone.

- The switching equipment components shall be secured to switch and connect directive communication and emergency call from the emergency telephone installed in roadside whenever required during the emergency cases.

- The switching system shall be complied with the international standard.

- The switching equipment components shall have no incompatibility of interfaces for connection with the transmission equipment components.

- There are several types of directives from the Main Center such as directive to all, directive to concerned division, directive to the specific region(s), and directive to a specific individual. The switching equipment components shall be capable to realize these different types of directives in accordance with directions made by the operator through the directive communication console.

- The administrative telephone which is utilized in normal operation condition shall be capable of connecting Public Switched Telephone Network (PSTN) in addition to the connection among Main Center, Road Management Office (RMO), Toll Management Office (TMO) and Rest Area.

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

- The switching equipment component shall be those types whose usefulness have been confirmed by road operators, communication carriers or operators in the countries other than the original manufacturing country.

7.2 Structure

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

- The switching equipment components shall have the structure which is possible to fix in the building, housing or cabinet.

- The structure of switching equipment components shall be capable to replace the faulty parts simply and easily when it is detected.

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

7.3 Performance

- The performance of the switching equipment components shall be guaranteed so as to switch and connect the required communication traffic in appropriate timing within the requirements stipulated in the concerned sections of this General Specifications.

- The directive communications, emergency telephone and Administrative Telephone shall be complied with the conditions of Class 0 of ITU-T Recommendation Y.1541 at least.

- The directive from Main Center in emergency case 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 be complied with or equivalent to the quality of fixed line telecommunications carrier. However, the following performance shall be complied with at least;

  Directive Communication:

  From Directive Console to the terminal equipment component to receive the directive call: within 18dB

  Emergency Telephone:

  From Emergency Telephone equipment component to receiving telephone equipment component : 22 dB

  Voice Communication under normal operation cases:

  From end terminal equipment component to the another end terminal equipment component: within 26dB

7.4 Human Machine Interfaces

- The switching equipment components shall be equipped the human-machine interface in order for operation and maintenance staff to make diagnosis of the switching system, input the necessary command, and execute necessary operation and maintenance activities.

- The switching equipment components 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.

7.5 Communication Interfaces

- The communication interfaces of the switching equipment components shall be complied with the international standard

7.6 Installation

- The switching equipment components shall be installed in air conditioned room, in Main Center building/Road Management Office or Toll Office basically.
- 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 switching equipment components bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

8. Directive Communication Console

8.1 Functions

- The directives from the Main Center shall be switched and connected without any connection loss in accordance with the options selected by operator through the Directive Communication Console.
- There are several types of directives from the Main Center such as directive to all, directive to concerned division, directive to the specific region(s), and directive to a specific individual. The directive communication console shall be capable to realize these different types of directives simply and clearly.
- The fault of the directive communication console equipment components shall be capable to be detected, and shall be notified to the operating staff. During emergency repairing time after detection of the system fault, continuous operation shall be secured with the redundant equipment component without any interruption.
- The directive communication console equipment components shall be those types whose usefulness have been confirmed by road operators, communication carriers or operators in the countries other than the original manufacturing country.

8.2 Structure

- The directive communication console equipment components shall have sufficient durability for 24hours a day, 365 days a year.
- The directive communication console equipment components shall be capable to be installed in the main center building.
- The structure of directive communication equipment components shall be capable to replace the faulty parts simply and easily when it is detected.
- The structure of directive communication equipment components shall be capable to implement the periodical checking and clean up activities.

8.3 Performance

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

  Directive Communication:

  From Directive Console to the terminal equipment component to receive the directive call: within 18dB

8.4 Human Machine Interfaces

- The directive communication console at main center shall be equipped necessary Human Machine Interfaces for transmitting directives, receiving acknowledges, and voice communications.

8.5 Communication Interfaces

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

8.6 Installation

- 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 directive communication equipment components bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

9. Directive Telephone Equipment Component

9.1 Functions

- The directive telephone equipment component which receives directive from the Main Center shall be equipped with the function to notify it as directive with buzzer or flashing light to the operating staff of receiving side.

- The directive telephone equipment component shall be capable to response with button or similar mechanism when the staff receives the directive.

- The directive telephone equipment component shall be those types whose usefulness have been confirmed by road operators, communication carriers or operators in the countries other than the original manufacturing country.

9.2 Structure

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

- The structure of directive telephone equipment component shall be capable to replace the faulty parts simply and easily when it is detected.

9.3 Performance

- The directive telephone equipment component shall be operated simply.

- The speech quality of the voice communications shall be complied with or equivalent to the quality of fixed line telecommunications carrier. However, the following performance shall be complied with at least;

  Directive Communication:

  From Directive Console to the terminal equipment component to receive the directive call: within 18dB

9.4 Human Machine Interfaces

- The directive telephone equipment component which receives directive from the Main Center shall be equipped with the function to notify it as directive with buzzer or flashing light to the operating staff of receiving side.

- The directive telephone equipment component shall be capable to response with button or similar mechanism when the staff receives the directive.

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 hindrance of its communication.

9.6 Installation

- 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 directive telephone terminal bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

10. Administrative Telephone Equipment Component

10.1 Functions

- The administrative telephone shall be capable of connecting Public Switched Telephone Network (PSTN) in addition to the connection among Main Center, Road Management Office (RMO), Toll Management Office (TMO) and Rest Area.

- The administrative telephone equipment component shall be those types whose usefulness have been confirmed by road operators, communication carriers or operators in the countries other than the original manufacturing country.

10.2 Structure

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

10.3 Performance

- The speech quality of the voice communications shall be complied with or equivalent to the quality of fixed line telecommunications carrier. However, the following performance shall be complied with at least;

  Administrative Voice Communication:

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

10.4 Human Machine Interfaces

- The key arrangement of administrative telephone equipment component 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 other connecting communication equipment components and shall not be hindrance of its communication.

10.6 Installation

- 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 administrative telephone equipment components bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

11. Emergency Telephone Equipment Component

11.1 Functions

- The Emergency Telephone equipment component shall be capable of connecting to the receiving telephone to be installed at Road Management Office in case of emergency.

- The emergency telephone equipment component shall be those types whose usefulness have been confirmed by road operators, communication carriers or operators in the countries other than the original manufacturing country.

11.2 Structure

- The emergency telephone equipment component is not utilized in normal operation conditions except for maintenance time however it shall have sufficient durability so that it is able to function properly whenever required.

- The emergency telephone equipment component shall be installed in the cabinet or chassis in order to secure the performance of it, and to be installed outside of the guard rail with appropriate height.

- The structure of emergency telephone equipment component shall be capable to replace the faulty parts simply and easily when it is detected.

11.3 Performance

- The speech quality of the voice communications shall be complied with or equivalent to the quality of fixed line telecommunications carrier. However, the following performance shall be complied with at least;

  Emergency Telephone:

  From Emergency Telephone equipment component to receiving telephone equipment component: 22 dB

11.4 Human Machine Interfaces

- The Human Machine Interface of emergency telephone equipment component shall be simple and easy so that the user is able to use it without experience.

11.5 Communication Interfaces

- All of the interfaces of emergency telephone equipment components shall be compatible to other connecting communication equipment components and shall not be hindrance of its communication.

11.6 Installation

- 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 emergency telephone equipment component bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

12. Receiving Telephone Equipment Component for Emergency Call

12.1 Functions

- The equipment component which receives emergency call from emergency telephone to be installed at roadside shall be equipped the function to notify it as emergency call to the operating staff of receiving side.

- The equipment component for receiving telephone shall be those types whose usefulness have been confirmed by road operators, communication carriers or operators in the countries other than the original manufacturing country.

12.2 Structure

- The receiving telephone equipment component for emergency call is not utilized in normal operation conditions except for maintenance time however it shall have sufficient durability so that it is able to function properly whenever required.

- The structure of receiving telephone equipment component shall be capable to replace the faulty parts simply and easily when it is detected.

12.3 Performance

- The speech quality of the voice communications shall be complied with or equivalent to the quality of fixed line telecommunications carrier. However, the following performance shall be complied with at least;

  Emergency Telephone:

  From Emergency Telephone equipment component to receiving telephone equipment component: 22 dB

12.4 Human Machine Interfaces

- The receiving telephone equipment component which receives emergency call from the emergency telephone shall be equipped with the function to notify it as directive with buzzer or flashing light to the operating staff of receiving side.

12.5 Communication Interfaces

- All of the interfaces of receiving telephone equipment components shall be compatible to other connecting communication equipment components and shall not be hindrance of its communication.

12.6 Installation

- 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 switching equipment components bonding with the grounding of lightning protection system and other grounding facilities installed within short distance.

13. Ambient Conditions

- The switching equipment components shall be accommodated in the air conditioned clean room or cabinet equivalent to IP66 to keep the performance of the equipment components.

- The spare parts of the switching equipment components shall be accommodated in the air conditioned clean room to keep the performance of it. The accommodation

conditions shall be subject to the individual equipments requirements to the storage environment.

- In case the equipment component such as emergency telephone is to be installed at outside, it shall be installed in the cabinet or chassis of IP65 or equivalent in order to secure the performance of the equipment component.

- The equipment component to be installed outside shall be capable to withstand natural conditions, meteorological conditions, electromagnetic noise, and other environmental conditions in Vietnam.

14. Power Supply

- The electric power supply for switching equipment components shall be equipped the back up power supply for securing the operation for 24 hours a day 365 days a year.

- The back up electric power supply for the equipment components related to directive communications shall be capable to operate it at least 24hours during commercial power failure.

15. Maintainability

- The equipment components shall be maintained easily and simply.

- The switching equipment components shall be capable to identify the faulty parts easily in case the fault is detected, and the replacement of the parts shall be simple.

- The Manufacturer shall guarantee the availability of spare parts of the supplied equipment components at least five (5) years after the equipment components are handed over to the road management authority

- The manufacturer of the switching 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 switching equipment components shall make a contract on technical support related to the delivered equipment components during the operation and maintenance period with the road management authority and the manufacturer/supplier shall provide the necessary services based on that contract.

16. 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.

17. Testing/Inspection

1) General

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

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

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

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

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

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

(6) The test and inspection procedure of the connection test between switching system and terminal equipment component shall be submitted to the road management authority and the consultant

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (2)

CCTV Monitoring

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following Documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
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- Draft Communication System Plan

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Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

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1. General Outlines

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

2. Scope

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

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)
- IEEE 802.3: (Ethernet)
- ISO/IEC 14496: (Coding of audio-visual objects)
- FCC RJ-45: (modular connector)

2) National Standards

- TCVN4054:2005 Đường ô tô - Yêu cầu thiết kế

4. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Incident:** An unusual and unplanned event that affects or impedes the normal flow of traffic, such as traffic accidents, broken-down vehicles, left obstacles, reversing vehicles, vandalism and natural disaster on the road.
- **Main Center:** The Center in charge of traffic monitoring, traffic control and traffic information dissemination, and is to be cooperated with road management offices.
- **Road Management Office:** An office in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring equipment for surveillance.
- **Draft General Specifications:** The Draft General Specifications defines required

processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.

- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
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- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **CCTV Monitoring:** This functional package allows the road operators to capture current situation of traffic accidents, broken-down vehicles, left obstacles, driving in the reverse direction, vandalism, natural disaster and traffic conditions on the expressways and to monitor the captured video image at the Main Centers and road management offices by using cameras installed at road sections where traffic can be stuck easily by incidents and at long tunnel sections.
- **Traffic Information:** This functional package allows the road operators to provide other organizations with the information organized as traffic events on the expressways by using the Internet.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **CCTV Camera:** Closed-Circuit Television Camera, which is used for producing images or recordings for surveillance purposes, and can be either video camera, or digital stills camera. Video cameras are either analogue or digital, so that they work on the basis of sending analogue or digital signals to a storage device such as a video tape recorder or computer. Video cameras are network cameras or IP cameras when embedded a video server having an IP address for video and audio streaming.
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer

multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.

5. Requirements

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

- System shall be capable of recognizing the severity of incidents through identifying types of vehicles involved (such as trucks, buses and sedans) by appearances.

- System shall be capable of identifying the place of incident occurrence at the Main Center and road management office.

- System shall be capable of installing roadside equipment adequately at bottleneck spots on the road where traffic can be stuck easily by incident and at tunnel sections.

- System shall be capable of controlling roadside equipment remotely from the Main Center in ordinary time and from road management office at a occurrence of incident.

- System shall be capable of minimizing the required number of monitoring devices.

- System shall be capable of minimizing load caused by data transmission including video image on the communication system.

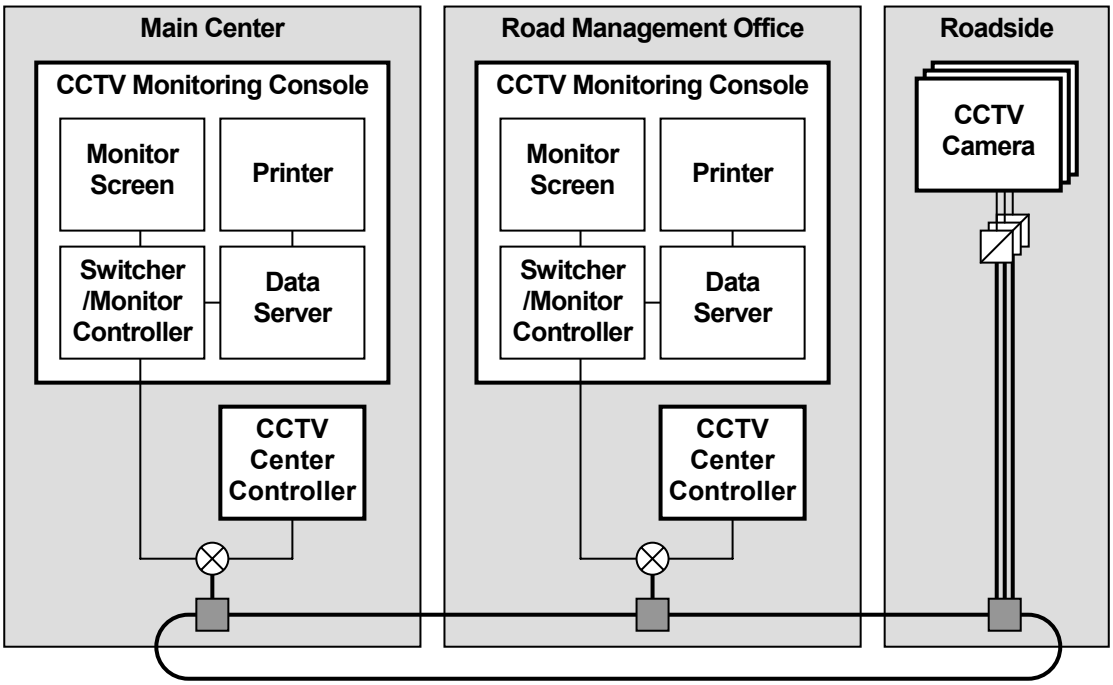
- System shall be capable of storing the needed video image.

- System shall be capable of indicating and printing out the needed results.

- System shall be capable of saving implementation cost by utilizing technologies defused for the Internet.

- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

6. System Architecture



: Location : Equipment Package : Detailed Device

: Software : Switching Hub & Media Converter : Media Converter

: SDH Node : Fibre Optic Cable : Copper Cable

Broken Lines: Outside of This Functional Package

7. CCTV Camera

7.1 Functions

- The system shall be capable of monitoring vehicles on the expressway and identifying types of the vehicles by their appearances.

- The system shall be capable of shooting road traffic by using black/white or colour image continuously 24 hours a day, 365 days a year excluding time for regular maintenance.

- The system shall be capable of synchronizing its clock to the clock of "CCTV Center Controller" at the start-up. By the clock synchronization, the system can be capable of picking out required images from the accumulated images from all cameras.

- CCTV shall be capable of correcting brightness of captured image automatically. (That is called as the function of iris.)

- CCTV shall have auto-focus function to be controlled by using "CCTV Monitor Console"

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected with the measures against water, rust, dust, salt water in case equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall be capable of having adequate structure for performing 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 absorbing 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 outdoor in road typical section in accordance with IPX 66 of the international standards

IEC 60529 or equivalent.

- CCTV camera shall be protected with the countermeasures against dust ingress if it will be installed outdoor in road tunnel section in accordance with IPX 64 of the international standards IEC 60529 or equivalent.

- The system shall be capable of fully meeting the requirements even under the conditions of nighttimes.

- The camera shall be capable of complying with CS–mount standard.

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

7.3 Performance

- The field of view shall be 14,000mm in width and 4,750mm in height or over.

- The object speed shall be 0~180km/h or over.

- 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 be capable of presetting lens and pan head of the camera according to a control signal.

- The system shall have the interface of video image output to adjust angle of view of camera and the interface of receiving control signal to check camera operations at setting-up on installation site.

- The system shall have defrosting function.

- The equipment components shall be capable of shooting 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 system shall have zooming function.

- The system shall have panning/tilting function. These functions are can be provided by using camera platform or all-in-one camera.

- The equipment component shall be supplied with Device Driver for controlling camera functions of panning/tilting and zooming. The camera shall be supported to interface of “CCTV Monitoring Console” as possible.

- The function of panning/tilting and zooming of the CCTV cameras shall be controlled remotely and respectively using a keypad of the console in the Main Center. The camera control shall be conducted using IP corresponding to the camera identification number.

Table 1 Minimal Specification of CCTV Camera

	Typical Section	Tunnel Section
Camera Unit		
Image sensor	CCD Sensor Colour or B/W (CMOS Sensor is selectable)	CCD Sensor Colour or B/W (CMOS Sensor is selectable)
Valid pixel of Sensor	> 380,000 pixel	> 380,000 pixel
Illumination	2-100,000 lx (Day mode), 0.5-100,000 lx (Night mode)	0.5-10,000 lx
Resolution	> 480-360 pixel	> 480-360 pixel
Video Compression	MPEG-4 Part2 (ISO/IEC 14496-2) MPEG-4 Part10 (ISO/IEC 14496-10), AVS	MPEG-4 Part2 (ISO/IEC 14496-2) MPEG-4 Part10 (ISO/IEC 14496-10), AVS
Flame rate	> 15fps	> 15fps
Network Interface	100Base / 1GBase (RJ-45)	100Base / 1GBase (RJ-45)
Range of surveillance	> 150.000m	> 150.000m
Lens Unit		
Focal length of lens	< 3.8mm	< 3.8mm
Zooming	> 20x optical (remote control)	> 20x optical (remote control)
Focusing	Automatic	Automatic
Camera platform Unit		
Panning	+/- 170 degrees (remote control)	+/- 170 degrees (remote control)
Tilting	100 degrees (remote control)	100 degrees (remote control)
Programmable Preset	> 100 points	> 100 points
Housing Unit		
Ingress Protection	Equivalent IP66 *1	Equivalent IP64*2
Relative Humidity	Average 20 – 80 % (shall be equipped Defroster)	Average 20 – 80 % (shall be equipped Defroster)
Acting temperature	Average 25 +/- 3 degrees C.	Average 25 +/- 3 degrees C.

*1. IP66: No ingress of dust; complete protection against contact. Water projected in powerful jets against the enclosure from any direction shall have no harmful effects.
*2. IP64: No ingress of dust; complete protection against contact. Water splashing against the enclosure from any direction shall have no harmful effect.
*3. Maximum range of surveillance: For a vehicle 1.5m wide to be recognized by the operator, the vehicle needs to be displayed clearly on the screen, size of the vehicle image on a 20-inch display more than 6mm

7.4 Communication Interfaces

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is TCP/IP.

- The equipment components shall be capable of having following communication interfaces in order to ensure that equipment components to be controllable to CCTV, and accessible to CCTV video images from another equipment / console.
  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Transmission data format
  - Timing chart and other details of the standard interfaces

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

7.5 Installation

- CCTV Camera installation height shall be 4.75m or more at the road typical section, and 4.00mm at tunnel section, in accordance with the limit construction clearance in accordance with TCVN 4054:2005.

- CCTV camera shall be capable of being vertically and horizontally adjusted during installation at roadside.

- Horizontal and vertical angle of CCTV camera shall be capable of being adjusted and fixed appropriately at the installation site.

- The equipment components shall have adequate robustness against the wind of 60m/s speed or equivalent.

8. Central CCTV Controller

8.1 Functions

- The function of panning/tilting and zooming of the CCTV cameras shall be controlled remotely and respectively using a keypad of the console in the Main Center. The camera control shall be conducted using IP corresponding to the camera identification number.

- The CCTV camera shall be capable of being controlled by “Main Center” or “Road Management Office” depending on the given priority.

- The system shall be capable of synchronizing its clock to the clock of “CCTV Center Controller” at Main Center at the start-up period.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- Chassis of equipment shall be capable of absorbing temperature rising from inside equipment.

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

8.3 Performance (including Reliability)

Table 2 Specification of Center Control and Peripheral device

	Specification
Control Unit	
Output / Input signal	IEEE 802.3 (Ethernet)
Video Compression	MPEG-4 Part2 (ISO/IEC 14496-2) MPEG-4 Part10 (ISO/IEC 14496-10), AVS
Bit Rate	Less than 3Mbps
Flame rate	15~30 fps
Protocol	IP, UDP, RTP, Multicast
Interface	100BASE / 1GBASE (IEEE 802.3)
Connector	RJ-45
Record Unit (Option)	
Resolution	> 480-360 pixel
Flame rate	> 5 fps
Media Converter / SW-HUB	
Interface	100BASE / 1GBASE / 10GBASE (IEEE 802.3)
Apply optic cable	SM optic cable
Light wavelength	1.3 / 1.5 micro m
Connector	RJ-45

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

8.4 Communication Interfaces

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is TCP/IP.

- In order to secure the disclosure of following communication interfaces for the equipment components to be controllable to 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

- Unnecessary 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

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

- The equipment of component shall be installed in the Road Management Office and Main Center.

9. CCTV Monitoring Console

9.1 Functions

- The equipment components shall be capable of monitoring vehicles on the expressways and identifying the appearance of vehicles in following conditions;

  - The field of view shall be 14,000mm in width and 4,750mm in height or over
  - The object speed shall be 0~180km/h or over

9.2 Structure

- The equipment components shall be capable of having adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- Chassis of equipment shall be capable of absorbing temperature rising from inside equipment.

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

9.3 Performance

- The system shall be capable of controlling the camera zooming, the tilting and the panning functions.

- The system shall be capable of displaying the selected camera image on the designated monitor screen.

- Recommended size of monitor screen shall be (approx.) 20inchs or over.

- All camera images shall be capable of being displayed on Monitor Screen for the operating staff to monitor the traffic conditions.

- However, some issues are envisioned as follows:
  - The room space may not be enough to locate all necessary Monitor Screens.
  - The number of operators is not enough for monitoring all CCTV images displayed on Monitor Screens.

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

rotating interval.

- The system shall be capable of displaying retrieve results on the monitor.
- The system shall be capable of capturing CCTV images as still picture.
- The system shall be capable of printing captured still pictures by using A4 printer.
- The system shall be capable of printing displayed images by using A4 printer.
- The 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.

9.4 Human Machine Interfaces

- The equipment components shall have human-machine interface so as the Traffic Information Operator can input necessary commands into the system.
- "CCTV monitor console" shall be user-friendly equipment.

9.5 Communication Interfaces

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is TCP/IP.
- The equipment components shall be capable of having following communication interfaces in order to ensure that equipment components to be controllable to 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.

9.6 Installation

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

- The equipment of component shall be installed in the Road Management Office and Main Center.

10. Ambient Conditions

- The equipment component 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 ambient conditions. The conditions shown in Table 4.

Table 4 Ambient Conditions

	Temperature	Relative Humidity
Main Center Toll Management Center Toll Office	Average 25 +/- 3 degrees C.	Average 20 – 80 %
Outside	-0 degrees C < < +50 degrees C	Average < 95 %

11. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.

- System shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

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

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

13. 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.

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

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

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

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

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

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

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

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

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

3) Necessary Document

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

(1) The test and inspection procedure shall include test and inspection items, descriptions

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (3)

Event Detection (by Image)

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following Documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

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1. General Outlines

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

2. Scope

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, 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/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

4. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Traffic Event:** An unusual event that affects or impedes the normal flow of traffic, which can be categorized to incident, traffic congestion, significant weather, construction work and traffic regulation.
- **Main Center:** The Center in charge of traffic monitoring, traffic control and traffic information dissemination, and is to be cooperated with road management offices.
- **Road Management Office:** An office in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring equipment for surveillance.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.

- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Data Set:** A set of data elements included in a message with a strong relationship among them.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **Event Detection (by Image):** This functional package allows the road operators to automatically recognize occurrence of traffic accidents, broken-down vehicles and left obstacles on the expressways and to send notification to the Main Centers and road management offices by analyzing video images from cameras installed at bottleneck spots where traffic can be easily stuck and at long tunnel sections.
- **Vehicle Detection:** This functional package allows the road operators to measure actual traffic volume, heavy vehicle ratio and vehicle velocity on the expressways for developing road operation/ improvement plans by using vehicle detectors installed at important points on the throughway and the tollgates.
- **Toll Management:** 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 installed in the road management office.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **CCTV Camera:** Closed-Circuit Television Camera, which is used for producing images or recordings for surveillance purposes, and can be either video camera, or digital stills camera. Video cameras are either analogue or digital, so that they work on the basis of sending analogue or digital signals to a storage device such as a video tape recorder or computer. Video cameras are network cameras or IP cameras when embedded a video server having an IP address for video and audio streaming.

- **Image Recognition:** Software technology that uses computer algorithms to intelligently monitor real-time video for automatically recognizing license plate number of vehicle, vehicle speed, the occurrence of traffic accidents, broken-down vehicles, and left obstacles.
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.

5. Requirements

- System shall be capable of detecting incident occurrences and their types, such as traffic accidents, breakdown vehicles, left obstacles, driving in the reverse direction, vandalism and natural disaster, automatically and promptly by analyzing video image captured at roadside.

- System shall be capable of measuring number of vehicles and vehicle speed at a specific point on the road.

- System shall be capable of notifying the detected results automatically and promptly to the Main Center road and management office.

- System shall be capable of monitoring original video image remotely at the Main Center and road management office.

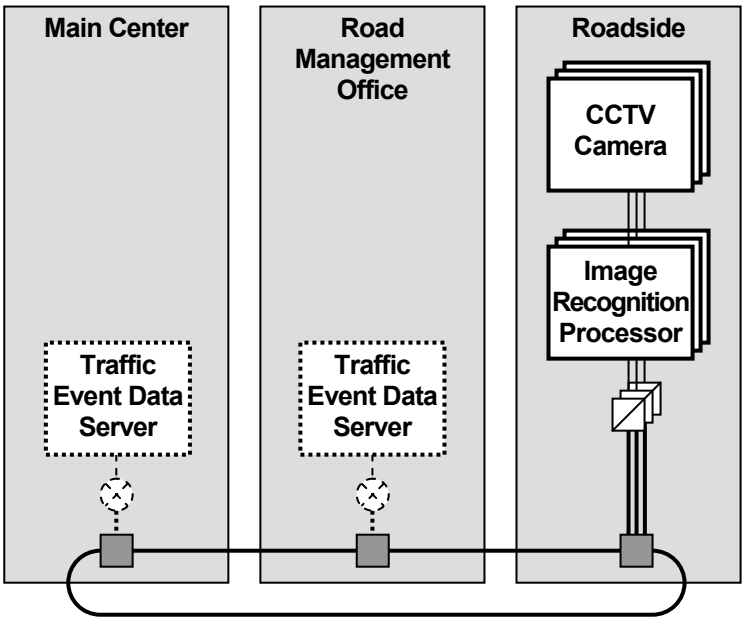
- System shall be capable of identifying the time and place of incident occurrence at the Main Center and road management office.

- System shall be capable of installing roadside equipment adequately at bottleneck spots on the road where traffic can be stuck easily by incident and at tunnel sections.

- System shall be capable of minimizing load caused by data transmission including video image on the communication system.

- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

6. System Architecture



: Location : Equipment Package : Detailed Device

: Software : Switching Hub & Media Converter : Media Converter

: SDH Node : Fibre Optic Cable : Copper Cable

Broken Lines: Outside of This Functional Package

7. CCTV Camera

7.1 Functions

- The system shall be capable of monitoring vehicles on the expressway and identifying types of the vehicles by their appearances.

- The system shall be capable of taking a image of vehicle license number plate upon control signal.

- CCTV system shall be capable of correcting brightness of captured image automatically. (That is called as the function of iris.)

- 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 equipment components shall be capable of synchronizing its clock to the clock of “Traffic Supervising / Control Server” at the start-up.

7.2 Structure

- The countermeasures against dust and rainproof shall be taken on the CCTV camera installed in outside (except tunnels) according to the international standard IEC 60529 defined by IPX66 or equivalent.

- The system shall be capable of fully meeting the requirements even under the conditions of nighttimes.

- The camera shall be capable of complying with CS–mount standard.

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall be capable of having adequate structure for performing

maintenance works from the 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 absorbing temperature rising from inside equipment and radiant solar heat.

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

7.3 Performance

- Angle of field shall be 10,500mm in width and 4,750mm in height or over

- Object speed shall be 0~180km/h or over

- 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 be capable of zooming, correcting brightness and focusing of the camera according to the control signal.

- The equipment components shall be capable of setting up 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 the interface of video image output to adjust angle of view of camera and the interface of control signal receiving to check camera operations for setting-up at installation site.

- CCTV camera shall be capable of shooting road traffic by at least Black/White image for continuously 24 hours a day for 365 days, except for maintenance and repair period.

- The system shall have zooming function.

- The equipment component shall be supplied with Device Driver for controlling camera functions of panning/tilting and zooming. The camera shall be supported to interface of “CCTV Monitoring Console” as possible.

- The function of panning, tilting and zooming of the CCTV cameras shall be controlled remotely and respectively using a keypad of the console in the Main Center. The camera control shall be conducted using IP corresponding to the camera identification number.

Table 1 Minimal Specification of CCTV Camera

	Typical Section
Camera Unit	
Image sensor	CCD Sensor Colour or B/W (CMOS Sensor is selectable)
Valid pixel of Sensor	> 380,000 pixel
Illumination	2-100,000 lx (Day mode), 0.5-100,000 lx (Night mode)
Resolution	> 720 x 486 pixel
Video Compression	MPEG-4 Part2 (ISO/IEC 14496-2) MPEG-4 Part10 (ISO/IEC 14496-10), AVS
Flame rate	> 30fps
Network Interface	100Base / 1GBase (RJ-45)
Range of surveillance	> Installation height of CCTV x 10times
Lens Unit	
Focusing	Automatic
Housing Unit	
Ingress Protection	Equivalent IP66 *1
Relative Humidity	Average > 90 % (shall be equipped Defroster)
Acting temperature	-0 degrees C < +50 degrees C

*1. IP66: No ingress of dust; complete protection against contact. Water projected in powerful jets against the enclosure from any direction shall have no harmful effects.

7.4 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is TCP/IP.

- The equipment components shall be capable of having following communication interfaces in order to ensure that equipment components to be controllable to CCTV, and accessible to CCTV video images from another equipment / console.
  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Transmission data format
  - Timing chart and other details of the standard interfaces

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

7.5 Installation

- The equipment components shall be appropriately installed at the lighting post on the roadside and or on overhead gantry of expressway where they are capable of shooting the image of vehicles.

- CCTV Camera installation height shall be 4.75m or more at the typical section, in accordance with the highway clearance limits stipulated in TCVN4054:2005.

- Horizontal and vertical angle of CCTV camera shall be adjustable, and shall be fixed appropriately.

- CCTV camera be capable of being vertically and horizontally adjusted during installation at roadside.

- Equipment components shall have adequate robustness against the wind of 60m/s speed or equivalent.

8. Image Recognition Processor

8.1 Functions

- The equipment components shall be capable for recognition following occurrences on the expressway automatically from CCTV images. Then the result of recognition is transmitted to "Traffic Event Data Server".
  <Incident Occurrence>
  - Stopped Vehicle
  - Wrong-way Vehicle
  - Speed drop

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

- The equipment components shall be capable of synchronizing its clock to the clock of "CCTV Monitoring Console" at the start-up.

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

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected with the measures against water, rust, dust, salt water in case the equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall have adequate structure for performing maintenance works from the 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 absorbing temperature rising from inside equipment and radiant solar heat.

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

8.3 Performance

- Distance of Recognition: equivalent to Installation height of CCTV x 10times or over

- The equipment components shall be capable of transmitting the recognized Incident Occurrence and Traffic Data to “Traffic Event Data Server”. Transmitting data is shown on Table 2.

Table 2 Data Frame for Event Detection

Data Set	Principal Data Element	Update Cycle	Storage Period
Image Recognition Results Data set	Roadside Equipment ID	Event Detected	12 months
	Date	Event Detected	12 months
	Time	Event Detected	12 months
	Traffic Event Category	Event Detected	12 months
	Traffic Event Class	Event Detected	12 months
Event Image Date set	Video Image of Event	Event Detected	12 months

Table 3 Data Frame for Vehicle Detection

Data Set	Principal Data Element	Update Cycle	Storage Period
Vehicle Detection Data set	Roadside Equipment ID	Transmitting	12 months
	Date	Transmitting	12 months
	Time	Transmitting	12 months
	Cumulative Number of Vehicles	Each Vehicle passing	12 months
	Vehicle Speed	Each Vehicle passing	12 months
	Vehicle Length	Each Vehicle passing	12 months
	Traffic Congestion Status	Each Vehicle passing	12 months

- The equipment components shall be capable of discretionarily setting the unit time of volume, average speed, occupancy and traffic flow speed .

- The equipment components shall be capable of digitalising and outputting the reliability of recognition result which represents the accuracy of the number plate recognition results. (in case the recognition for incident occurrence)

- In case of the reliability of recognition results below the threshold level, the equipment of components shall be capable of not transmitting the result of event detection to “Traffic Event Data Server”.

- The equipment components shall be capable of automatically recording the CCTV video images during 2minutes around the time of incident occurrence. Then the recorded images are transmitted to “Traffic Event Data Server”.

- All results of event detection shall be logged including not transmitted results.

- The system shall have the interface of video image output to adjust angle of view of camera and the interface of control signal receiving to check camera operations for setting-up at installation site.

8.4 Communication Interface

- The system shall be capable of transmitting all data and signals in the Ethernet, communication protocol is TCP/IP.

- **The system shall have following interfaces** between transmission devices;
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the standard interfaces

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

8.5 Installation

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

9. Ambient Conditions

- The equipment component 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 ambient conditions. The conditions are shown in Table 3.

Table 3 Ambient Conditions

	Temperature	Relative Humidity
Main Center Toll Management Center Toll Office	Average 25 +/- 3 degrees C.	Average 20 – 80 %
Outside	-0 degrees C < < +50 degrees C	Average < 95 %

10. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.

- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

11. Maintainability

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

- The equipment components shall be capable of identifying the faulty parts easily in case equipment fault is detected, and the replacement of the parts shall be simple.

- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.

- The manufacturer of the equipment components shall submit the necessary documents necessary for the operation and maintenance such as manuals and check list, and necessary training shall be provided to the staffs to be work as O&M staffs of the related equipment components.

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

12. 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.

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

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

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

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

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

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

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

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (4)

Vehicle Detection

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following Documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

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

2. Scope

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

4. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Traffic Event:** An unusual event that affects or impedes the normal flow of traffic, which can be categorized to incident, traffic congestion, significant weather, construction work and traffic regulation.
- **Main Center:** The Center in charge of traffic monitoring, traffic control and traffic information dissemination, and is to be cooperated with road management offices.
- **Road Management Office:** An office in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring equipment for surveillance.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set

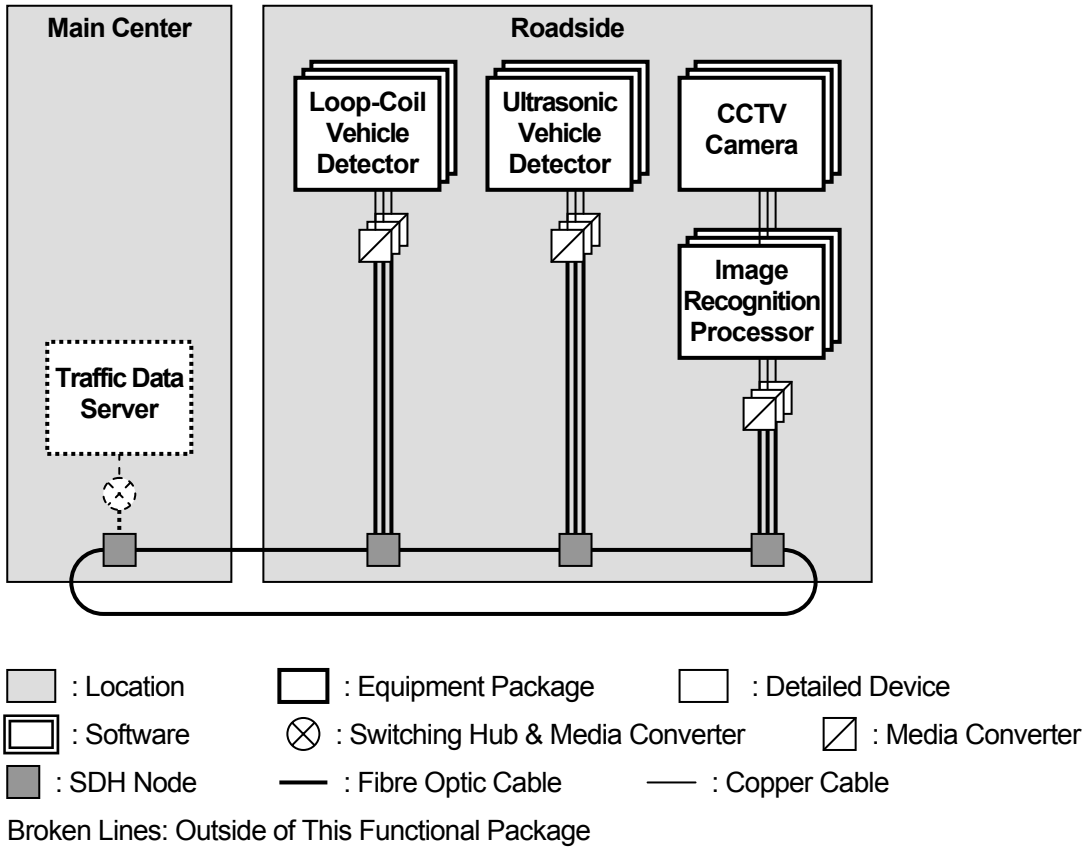
up corresponding to the equipment components.

- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Data Set:** A set of data elements included in a message with a strong relationship among them.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **Vehicle Detection:** This functional package allows the road operators to measure actual traffic volume, heavy vehicle ratio and vehicle velocity on the expressways for developing road operation/ improvement plans by using vehicle detectors installed at important points on the throughway and the tollgates.
- **Toll Management:** 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 installed in the road management office.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **CCTV Camera:** Closed-Circuit Television Camera, which is used for producing images or recordings for surveillance purposes, and can be either video camera, or digital stills camera. Video cameras are either analogue or digital, so that they work on the basis of sending analogue or digital signals to a storage device such as a video tape recorder or computer. Video cameras are network cameras or IP cameras when embedded a video server having an IP address for video and audio streaming.
- **Image Recognition:** Software technology that uses computer algorithms to intelligently monitor real-time video for automatically recognizing license plate number of vehicle, vehicle speed, the occurrence of traffic accidents, broken-down vehicles, and left obstacles.
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.

5. Requirements

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

6. System Architecture



7. Loop-coil Vehicle Detector

7.1 Functions

- The system shall be capable of measuring required data for compiling following traffic data, at least.
  - Traffic volume (by all lane, by one lane, by vehicle category and by hour)
  - Average speed (for every 1 minutes, 15 minutes, 1 hour)
  - Vehicle Length

- The system shall be capable of transmitting the measuring data to “Traffic Data Server”.

- 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 synchronizing its clock to the clock of “Traffic Supervising / Control Server” at the start-up.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall have adequate structure for performing maintenance works from the its 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 absorbing temperature rising from inside equipment and radiant solar heat.

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

7.3 Performance

- The equipment components shall be capable of transmitting measured Traffic Data to "Traffic Event Data Server". Transmitting data is shown on Table 1.

Table 1 Data Frame for Vehicle Detection

Data Set	Principal Data Element	Update Cycle	Storage Period
Vehicle Detection Data set	Roadside Equipment ID	Transmitting	12 months
	Date	Transmitting	12 months
	Time	Transmitting	12 months
	Cumulative Number of Vehicles	Each Vehicle passing	12 months
	Vehicle Speed	Each Vehicle passing	12 months
	Vehicle Length	Each Vehicle passing	12 months
	Traffic Congestion Status	Each Vehicle passing	12 months

- The system shall have the interface of video image output to adjust angle of view of camera and the interface of control signal receiving to check camera operations at setting-up on installation site.

7.4 Communication Interface

- 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

- 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.

8. Ultrasonic Vehicle Detector

8.1 Functions

- The system shall be capable of measuring required data for compiling following traffic data, at least.
  - Traffic volume (by all lane, by one lane, by vehicle category and by hour)
  - Average speed (for every 1 minutes, 15 minutes, 1 hour)
  - Vehicle Length

- The system shall be capable of transmitting the measured data to “Traffic Data Server”.

- 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 synchronizing its clock to the clock of “Traffic Supervising / Control Server” at the start-up.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall have adequate structure for performing maintenance works from the it’s sides and/or back, but not from lane direction, in order to minimize the influence to traffic activities.

- Chassis of equipment shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.

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

8.3 Performance

- The equipment components shall be capable of transmitting measured Traffic Data to "Traffic Event Data Server". Transmitting data is shown on Table 2.

Table 2 Data Frame for Vehicle Detection

Data Set	Principal Data Element	Update Cycle	Storage Period
Vehicle Detection Data set	Roadside Equipment ID	Transmitting	12 months
	Date	Transmitting	12 months
	Time	Transmitting	12 months
	Cumulative Number of Vehicles	Each Vehicle passing	12 months
	Vehicle Speed	Each Vehicle passing	12 months
	Vehicle Length	Each Vehicle passing	12 months
	Traffic Congestion Status	Each Vehicle passing	12 months

- The system shall have the interface of video image output to adjust angle of view of camera and the interface of control signal receiving to check camera operations at setting-up on installation site.

8.4 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is 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 equipment components consist of an amplifier, a data logger and Ultrasonic sensor.
- The amplifier and the data logger shall be located in the chassis on roadside. The sensor shall be mounted above the ground and beam a cone shaped area.

9. CCTV Camera

9.1 Functions

- The system shall be capable of monitoring vehicles on the expressway and identifying types of the vehicles by their appearances.

- The system shall be capable of taking a image of vehicle license number plate upon control signal.

- CCTV system shall be capable of correcting brightness of captured image automatically. (That is called as the function of iris.)

- 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 equipment components shall be capable of synchronizing its clock to the clock of “Traffic Supervising / Control Server” at the start-up.

9.2 Structure

- The countermeasures against dust and rainproof shall be taken on the CCTV camera installed in outside (except tunnels) according to the IPX66 of international standard IEC 60529or equivalent.

- The system shall be capable of fully meeting the requirements even under the conditions of nighttimes

- The camera shall be capable of complying with CS–mount standard.

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with 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 outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall be capable of having adequate structure for performing

maintenance works from the it's sides and/or back, but not from lane direction, in order to minimize the influence to traffic activities.

- Chassis of equipment shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.

- The equipment components shall be capable of being protected against interference from other electronic devices.

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

9.3 Performance

- Angle of field shall be: 7,000mm in width and 4,750mm in height or over

- Object speed shall be 0~180km/h or more

- 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 be capable of zooming, correcting brightness and focusing of the camera according to the control signal.

- The equipment components shall be capable of setting up 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 the interface of video image output to adjust angle of view of camera and the interface of control signal receiving to check camera operations for setting-up at installation site.

- CCTV camera shall be capable of shooting road traffic by at least Black/White image for continuously 24 hours a day for 365 days, except for maintenance and repair period.

- The system shall have zooming function.

Table 3 Minimal Specification of CCTV Camera

	Typical Section
Camera Unit	
Image sensor	CCD Sensor Colour or B/W (CMOS Sensor is selectable)
Valid pixel of Sensor	> 380,000 pixel
Illumination	2-100,000 lx (Day mode), 0.5-100,000 lx (Night mode)
Resolution	> 720 x 486 pixel
Video Compression	MPEG-4 Part2 (ISO/IEC 14496-2) MPEG-4 Part10 (ISO/IEC 14496-10), AVS
Flame rate	> 30fps
Network Interface	100Base / 1GBase (RJ-45)
Range of surveillance	> Installation height of CCTV x 10times
Lens Unit	
Focusing	Automatic
Housing Unit	
Ingress Protection	Equivalent IP66 *1
Relative Humidity	Average > 90 % (shall be equipped Defroster)
Acting temperature	-0 degrees C < +50 degrees C

*1. IP66: No ingress of dust; complete protection against contact. Water projected in powerful jets against the enclosure from any direction shall have no harmful effects.

9.4 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

- The transmission devices shall have following communication interfaces ;
  - Bit allocation, which is needed for designing data transmission between transmission devices
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- 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

- The equipment components shall be appropriately installed at the lighting post on the roadside and or on overhead gantry of expressway where they are capable of shooting the image of vehicles.

- CCTV Camera installation height shall be 4.75m or more at the typical section, in accordance with the highway clearance limits stipulated in TCVN4054:2005.

- Horizontal and vertical angle of CCTV camera shall be adjustable, and shall be fixed appropriately.

- CCTV camera be capable of being vertically and horizontally adjusted during installation at site.

- Equipment components shall have adequate robustness against the wind of 60m/s speed or equivalent.

10. Image Recognition Processor

10.1 Functions

- The system shall be capable of measuring required data for compiling following traffic data, at least.
  - Traffic volume (by all lane, by one lane, by vehicle category and by hour)
  - Average speed (for every 1 minutes, 15 minutes, 1 hour)
  - Vehicle Length

- The equipment components shall be capable of synchronizing its clock to the clock of "CCTV Monitoring Console" at the start-up.

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

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The equipment components shall have adequate structure, shape, size, lightweight and robustness.

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- The chassis of equipment shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.

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

10.3 Performance

- Distance of Recognition: equivalent to Installation height of CCTV x 10times or over

- The equipment components shall be capable of transmitting the measured Traffic Data to "Traffic Event Data Server". Transmitting data is shown on Table 4.

Table 4 Data Frame for Vehicle Detection

Data Set	Principal Data Element	Update Cycle	Storage Period
Vehicle Detection Data set	Roadside Equipment ID	Transmitting	12 months
	Date	Transmitting	12 months
	Time	Transmitting	12 months
	Cumulative Number of Vehicles	Each Vehicle passing	12 months
	Vehicle Speed	Each Vehicle passing	12 months
	Vehicle Length	Each Vehicle passing	12 months
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- The equipment of components is capable of discretionarily setting the unit time of volume, average speed, occupancy and traffic flow speed.

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

11. Ambient Conditions

- The equipment component 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 normally operating under the ambient conditions. The conditions are shown in Table 5.

Table 5 Ambient Conditions

	Temperature	Relative Humidity
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- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.

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- 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.

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

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

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

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

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

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

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (5)

Traffic Analysis

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following Documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

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

2. Scope

This Draft General Specifications deal with the equipment components and software to be installed in the Main Centres 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

4. Definitions of Terms

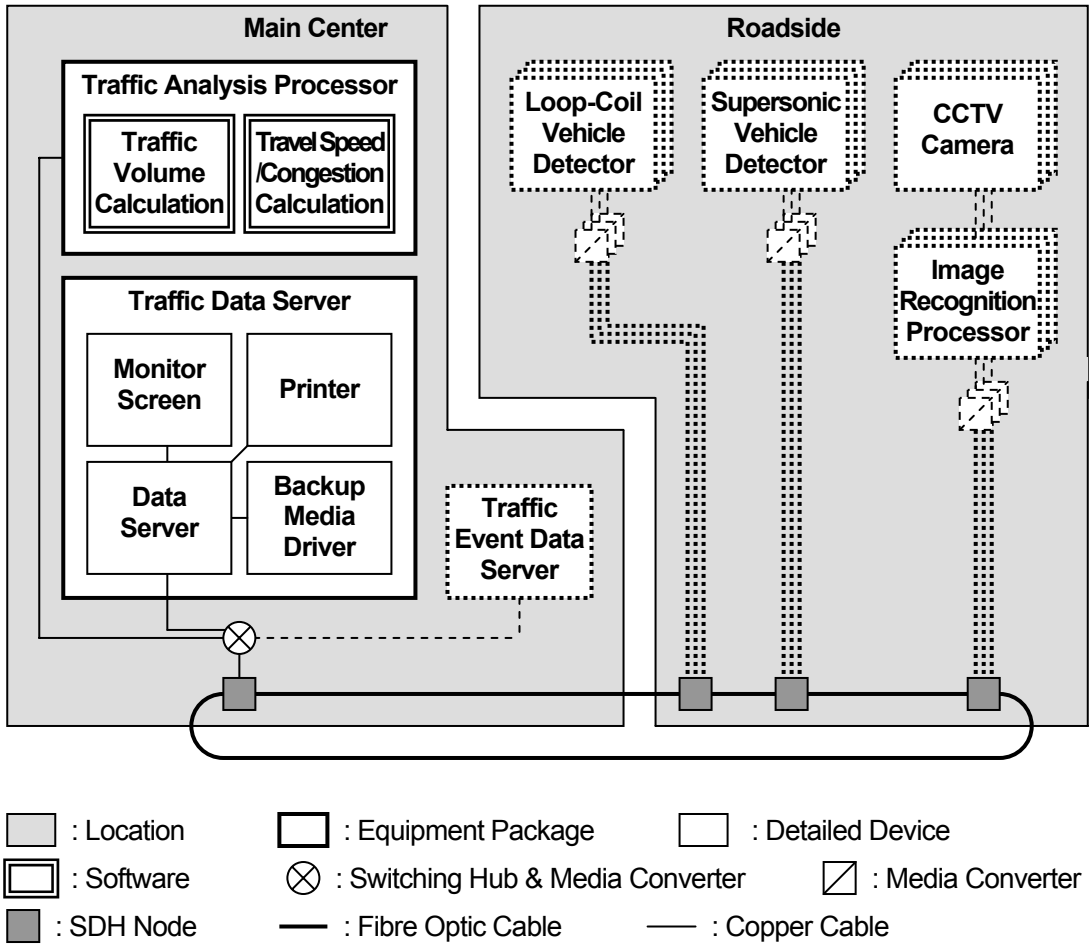
- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Traffic Event:** An unusual event that affects or impedes the normal flow of traffic, which can be categorized to incident, traffic congestion, significant weather, construction work and traffic regulation.
- **Main Center:** The Center in charge of traffic monitoring, traffic control and traffic information dissemination, and is to be cooperated with road management offices.
- **Road Management Office:** An office in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring equipment for surveillance.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.

- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Data Set:** A set of data elements included in a message with a strong relationship among them.
- **Vehicle Detection:** This functional package allows the road operators to measure actual traffic volume, heavy vehicle ratio and vehicle velocity on the expressways for developing road operation/ improvement plans by using vehicle detectors installed at important points on the throughway and the tollgates.
- **Traffic Analysis:** This functional package allows the road operators to keep track of traffic conditions on the expressways, such as crowdedness and vehicle velocity, by processing and analyzing the data captured by vehicle detectors.
- **Traffic Information:** This functional package allows the road operators to provide other organizations with the information organized as traffic events on the expressways by using the Internet.
- **Toll Management:** 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 installed in the road management office.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **Vehicle Detector:** A sensor either embedded in the pavement or mounted above the expressway to provide vehicle volume, speed, counts, headway, queue lengths, and vehicle classifications.
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.

5. Requirements

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

6. System Architecture



7. Traffic Analysis Processor (Traffic Volume Calculation)

7.1 Functions

- Software shall be capable of counting traffic volume at a specific point on the road based on the measured results by vehicle detectors.

- Software shall be capable of calculating heavy vehicle ratio at a specific point on the road based on the measured results by vehicle detectors.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- Chassis of equipment shall be capable of absorbing temperature rising from inside equipment.

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

7.3 Performance

- Software shall be capable of calculating the traffic volume by vehicle types (i.e. by vehicles having length of from 12.0m and above or less) at each specific point in every one (1) minute automatically, and the calculated results shall be stored in the Traffic Data Server.

- Software shall be capable of categorizing vehicles types by their vehicle length (i.e. standard-size vehicle, having length less than 12.0m and heavy vehicle, having length 12.0m or more. And total traffic volume of each type shall be calculated.

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

- At least, the software shall be capable of calculating following traffic data:
  - Traffic volume (of all lanes, each lane, vehicle type and every 1 hour)
  - Average speed (every 1 minute, 15 minutes, 1 hour)
  - Hourly traffic volume of each vehicle types, each lane within the total time of a year (24hours x 365days = 8760 hour)

- Software shall be capable of receiving the detected Traffic Data from “Vehicle Detector”. The data frame of the data is shown on Table 1.

Table 1 Data Frame for Vehicle Detection

Data Set	Principal Data Element	Update Cycle	Storage Period
Vehicle Detection Data set	Roadside Equipment ID	Transmitting	12 months
	Date	Transmitting	12 months
	Time	Transmitting	12 months
	Cumulative Number of Vehicles	Each Vehicle passing	12 months
	Vehicle Speed	Each Vehicle passing	12 months
	Vehicle Length	Each Vehicle passing	12 months
	Traffic Congestion Status	Each Vehicle passing	12 months

- Software shall be capable of displaying the calculated results of traffic data into table format and chart format.

- Software shall be capable of transmitting the calculated result of traffic data to “Traffic Event Data Server”.

- Software shall be capable of saving the compiled data in CSV form. It shall be capable of being accessed and modified by using commercially application software (such as Microsoft Excel).

7.4 Human Machine Interface

- Software shall be capable of equipping the human machine interface for displaying the statistical data shown below on the screen and printing it out.
  - 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

7.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

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

7.6 Installation

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

- The equipment of component shall be installed in the Main Center.

8. Traffic Analysis Processor (Speed/Congestion Calculation)

8.1 Functions

- Software shall be capable of automatically calculating average speed at Vehicle Detector installation point, which is 500m far from the forefront of junction, based on the results obtained from Vehicle Detector and Image Recognition Device.

- Software shall be capable of comparing calculated average speed at Vehicle Detector installation site with threshold, which is 500m far from the forefront of junction, and determining whether traffic congestion occurred not.

- Software shall be capable of automatically calculating average speed (km/h) at Vehicle Detector installation point every one minute, which is 500m far from the forefront of junction, and storing in Data Server, based on the speed data of each vehicle obtained from Vehicle Detector and Image Recognition Device.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- Chassis of equipment shall be capable of absorbing temperature rising from inside equipment.

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

8.3 Performance

- The software shall be capable of automatically identifying the situation to be traffic congestion in condition that the vehicles are lining up 1 km with driving speed under 40km/h continuously in more than 15 minutes, based on one-minute basis average speed result at Vehicle Detector's installation point , which is 500 m far from forefront of calculated junction.

- Software shall be capable of automatically identifying the situation to be heavy traffic if the driving speed is under 50 km/h continuously in more than 15 minutes. Based on the results of one-minute basis calculated average speed.

- Software shall be capable of storing the identified result of congestion to the Traffic Data Server with its average speed. In case, the identified result is categorized as traffic congestion, it shall be transmitted to the Traffic Event Data Server including the data of congested section of the expressways, time and average speed.

- Software shall be capable of calculating statistical data based on the stored individual vehicle speed data in Traffic Data Server, automatically. The statistical data includes the following data for individual representative points.

  - 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

- Software shall be capable of receiving the detected Traffic Data from "Vehicle Detector". The data frame of the data is shown on Table 2.

Table 2 Data Frame for Vehicle Detection

Data Set	Principal Data Element	Update Cycle	Storage Period
Vehicle Detection Data set	Roadside Equipment ID	Transmitting	12 months
	Date	Transmitting	12 months
	Time	Transmitting	12 months
	Cumulative Number of Vehicles	Each Vehicle passing	12 months
	Vehicle Speed	Each Vehicle passing	12 months
	Vehicle Length	Each Vehicle passing	12 months
	Traffic Congestion Status	Each Vehicle passing	12 months

- Software shall be capable of displaying the calculation result of average speed of each specific point into table format and chart format.

- Software shall be capable of transmitting the calculation result of traffic data to "Traffic Event Data Server".

- Software shall be capable of saving the compiled data in CSV form. It shall be capable of being accessed and modified by using commercially application software (such as Microsoft Excel).

8.4 Human Machine Interface

- Software shall have human machine interface to display the calculation result on average speed of the expressway (monthly, daily, hourly), traffic congestion condition, and also capable of printing it out.

8.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

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

8.6 Installation

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

- The equipment of component shall be installed in the Main Center.

9. Traffic Data Server

9.1 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.

9.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- Chassis of equipment shall be capable of absorbing temperature rising from inside equipment.

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

9.3 Performance

- The equipment shall be capable of transmitting the data of average speed and time, location ID which is identified as congestion to the Traffic Event Data Server.

Table 3 Data Frame of Traffic Event Data Set

Data Set	Data Elements	Definition
Traffic Event Data Set	Traffic Event Data ID	ID code of the traffic event data
	Causal Traffic Event Data ID	ID code of the causal traffic event data
	Date	Day/month/year when a traffic event occurred
	Time	Hour/minute/second when a traffic event occurred
	Line ID	Line number of the road where a traffic event occurred
	Kilometre Post	Kilometre post of the place where a traffic event occurred
	Road Link ID	Road link number of the place where the traffic event occurred
	Place Name ID	ID code of the place name where the traffic event occurred
	Traffic Event Category ID	Number of traffic event data category
	Traffic Event Class ID	Number of traffic event data class
	Main Center Check Status	Approval/disapproval of the Main Center
	Office Check Status	Approval/disapproval of the road management office
	Existing/Removed Status	Existence/removal of traffic event

- The Data Server shall have storage capacity to keep five(5) years data on traffic volume, average speed, and congestion condition, at least.

- The Data server shall be capable of executing backup of the stored data in the data server on the date which is set up in advance.

- The Data server shall be capable of executing the restoration of backup data.

- The Data Server shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).

9.4 Human Machine Interface

- The equipment shall have human machine interface in order to display stored traffic volume data, average speed, and traffic congestion information on the screen and print them out.

9.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is 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.

9.6 Installation

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

- The equipment of component shall be installed in the Main Center.

10. Ambient Conditions

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

- The equipment component shall be installed in the offices and protected from interferences of other electronic devices.

- The equipment component shall be capable of normally operating under the ambient conditions. The conditions shown in Table 1.

Table 1 Ambient Conditions

	Temperature	Relative Humidity
Main Center Toll Management Center Toll Office	Average 25 +/- 3 degrees C.	Average 20 – 80 %
Outside	-0 degrees C < < +50 degrees C	Average < 95 %

11. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.

- System shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

12. Maintainability

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

- The equipment components 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 necessary documents necessary for the operation and maintenance such as manuals and check list, and necessary training shall be provided to the staffs to be work as O&M staffs of the related equipment components.

- The manufacturer of the equipment components shall make a contract on technical support of operation and maintenance related to the delivered equipment components

with the road management authority, and the manufacturer shall provide the necessary services based on the contract.

13. 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.

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

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

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

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

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

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

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

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (6)

Weather Monitoring

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

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Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

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

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

3. Relevant Regulations and Standards

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

4. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Traffic Event:** An unusual event that affects or impedes the normal flow of traffic, which can be categorized to incident, traffic congestion, significant weather, construction work and traffic regulation.
- **Main Center:** The Center in charge of traffic monitoring, traffic control and traffic information dissemination, and is to be cooperated with road management offices.
- **Road Management Office:** An officeA2-(6) 1 in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring equipment for surveillance.
- **Interchange:** A junction connecting an expressway network and an arterial road network. That comprises grade separation and ramps to permit traffic on the expressway to pass through the junction without directly crossing other traffic on the arterial road.

- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **Weather Monitoring:** 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.
- **Weather Sensor:** A sensor installed at a specific point on the road for measuring rainfall, wind speed, visibility, air temperature and road surface temperature.

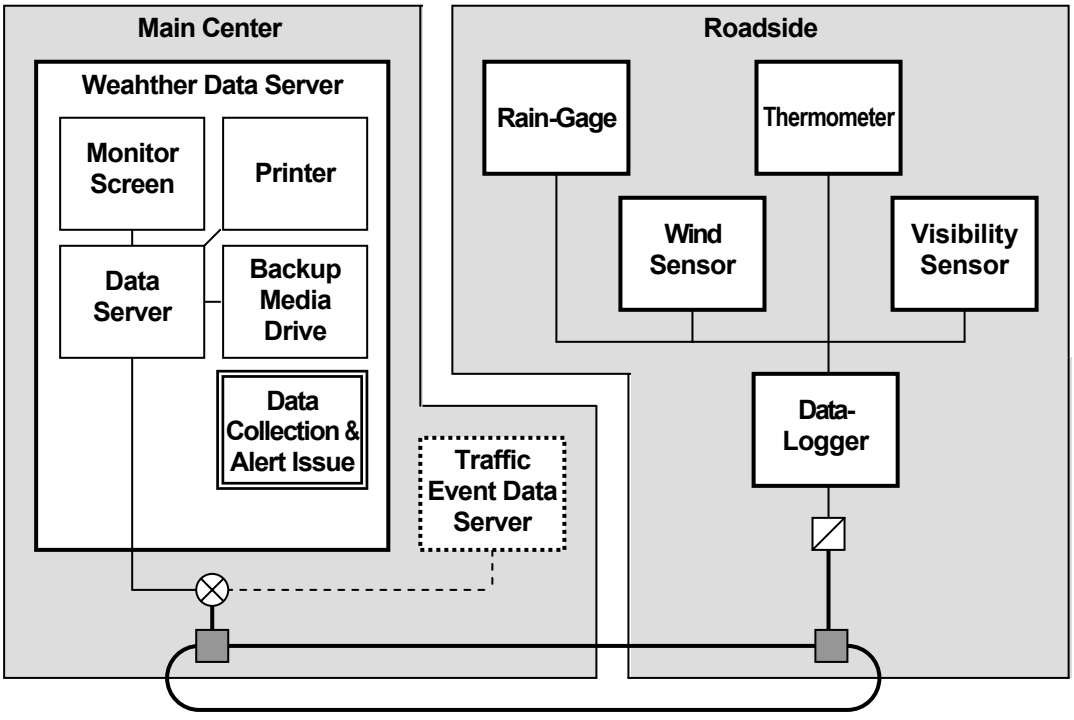
5. Requirements

- System shall be capable of measuring rainfall, wind speed, visibility, air temperature and road surface temperature at a specific point on the road.
- System shall be capable of measurement with accuracy for making decision of speed restrictions and closure in case that driving speed needs to be less than the maximum speed –70km/h.
- System shall be capable of sending the measured results automatically and promptly to the Main Center and road management office.
- System shall be capable of identifying the time and place of measured values at the Main Center and road management office.
- 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 sending a warning automatically and promptly to the Main Center and road management office in case that a measured result is beyond the limit defined in advance.
- System shall be capable of installing sensorss adequately at interchanges and important points on the expressways.
- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

6. System Architecture



: Location : Equipment Package : Detailed Device

: Software : Switching Hub & Media Converter : Media Converter

: SDH Node : Fibre Optic Cable : Copper Cable

Broken Lines: Outside of This Functional Pacakage

7 Rain Guage

7.1 Functions

- Rain guage shall be capable to observe precipitation with the performance specified in item 6.7.3 below.

- The observed data shall be capable to be updated every 5 minutes.

- Accumulated amount of precipitation shall be calculated based on the 5 minutes observed data and the result shall be capable to be stored.

7.2 Structure

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

- The structure of rain guage and related equipment component such as connecting cables shall be capable to withstand natural conditions, meteorological conditions, electromagnetic noise, and other environmewntal conditions in Vietnam.

7.3 Performance (including Reliability)

Performance of rain guage 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 20mm/h)
: max. +/- 3% (more than 20mm/h up to 100mm/h)
d) Funnel diameter : 200mm – 260mm

7.4 Human Machine Interfaces

- Maintenance equipment component or measuring tool which check rain guage performace shall be equipped necessary Human Machine Interface.

7.5 Communication Interfaces

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

7.6 Installation

- The rain guage shall be installed so as to obtain necessary meteorological observation data for expressway operation.

- The rain guage and related equipment components shall be installed outside of guard rail where it is not affect expressway operation and suitable for operation and maintenance of the rain guage and related equipment components such as data logger.

- The rain gauge shall be installed approx. 1.5m height;

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

8. Wind Sensor

8.1 Functions

- Wind sensor shall be capable to observe wind speed with the performance specified in item 6.8.3 below.

- The observed data shall be capable to be updated every 5 minutes.

- Average, maximum, minimum values shall be calculated based on the 5 minues observed data and those data shall be capable to be stored.

8.2 Structure

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

- 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 environmewntal conditions in Vietnam.

8.3 Performance (including Reliability)

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

  Wind speed sensor

  a) Measureing range : 2 to 50 m/sec
  b) Resolution : 0.1 m/sec

c) Accuracy : within +/- 3%

8.4 Human Machine Interfaces

- Maintenance equipment component or measuring tool which check wind sensor performace shall be equipped necessary Human Machine Interface.

8.5 Communication Interfaces

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

8.6 Installation

- The wind sensor shall be installed so as 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 affect expressway operation and suitable for operation and maintenance of the wind sensor and related equipment components such as data logger.

- The wind speed sensor shall be installed 2.5 – 5 m height.

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

9. Visibility Sensor

9.1 Functions

- Visibility sensor shall be capable to observe visibility with the performance specified in item 6.9.3 below.

- The observed data shall be capable to be updated every 5 minutes.

- Average, maximum, minimum values shall be calculated based on the 5 minues observed data and those data shall be capable to be stored.

9.2 Structure

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

- 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 environmewntal conditions in Vietnam.

9.3 Performance (including Reliability)

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

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

9.4 Human Machine Interfaces

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

9.5 Communication Interfaces

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

9.6 Installation

- The visibility sensor shall be installed so as 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 affect expressway operation and suitable for operation and maintenance of the wind sensor and related equipment components such as data logger.

- The visibility sensor shall be installed 1.5 - 2.5m height;

- 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

[1] MOR: Meteorological Optical Range

of lightning protection system and other grounding facilities installed within short distance.

10. Thermometer

10.1 Functions

- Thermometer shall be capable to observe air temperature with the performance specified in item 6.10.3 below.

- The observed data shall be capable tobe updated every 5 minutes.

- Average, maximum, minimum values shall be calculated based on the 5 minues observed data and those data shall be capable to be stored.

10.2 Structure

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

- 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 environmewntal conditions in Vietnam.

10.3 Performance (including Reliability)

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

  Thermometer for air temperature

  a) Masuring 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

10.4 Human Machine Interfaces

- Maintenance equipment component or measuring tool which check thermometer performace shall be equipped necessary Human Machine Interface.

10.5 Communication Interfaces

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

10.6 Installation

- The thermometer shall be installed so as 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 affect expressway operation and suitable for operation and maintenance of the wind sensor and related equipment components such as data logger.

- The thermometer shall be installed 1.5 – 2.0m height;

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

11. Data Logger

11.1 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 prosess 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 store the above calculation result at least two (2) hours.

- 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 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 is

happened. The data logger shall be capable to detect its own failure whenever it is happened.

- The data logger shall be capable to check weather sensor and its own operating conditions through inputting devices, and shall be capable to display the result on screen.

- The data logger shall be capable to detect the data which is out of measuring range or unlear, and shall be capable to identify it.

11.2 Structure

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

- 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 environmewntal conditions in Vietnam.

11.3 Performance (including Reliability)

- The data logger shall be capable enough to perform necessary functions stipulated in item 6.11.1.

- The data logger shall be synchronized with Weather Data Server and the sensor which equip its own clock.

11.4 Human Machine Interfaces

- The data logger shall be capable to equip Human Mashine Interface necessary for operation and maintenance such as key board for inputting command to check weather sensors and its own operating conditions, and screen which displays the result of it.

11.5 Communication Interfaces

- Communication interfaces shall be properly selected so as to function well on data and signal transmission between weater sensors and data logger.

- The data logger shall be equipped Ethernet interface to be required between the data logger and communication node.

11.6 Installation

- The data logger shall be installed outside of guard rail where it is not affect expressway operation and suitable for operation and maintenance.

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

12 Weather Data Server

12.1 Functions

- Weather data server to be located in the main center shall be capable to display each location of the observation site clearly on the topographic map on the connected screen to the server. The observation site shall be cleary identified by the operator.

- The weather data server shall be capable to display onserved data as each site and as each observation element respectively.

- The weather data server shall be capable to display each observed element data at each site on the topographic map.

- The weather data server shall be capable to collect observed data from each site and capable to update displayed data in every 5 minutes.

- The weather data server shall be capable to compile collected observed data into database.

- The weather data servewr shall be capable to detect the fact in case observed precipitation, wind speed or air temperature exceeds the corresponding threshold, or in case 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.

- In case observed precipitation, wind speed, air temperature exceeds the corresponding threshold, or in case observed visibility becomes shorter than the threshold, this detected result shall be capable to be recorded in the Traffic Event Data Server.

- The weather data servewr shall be capable to monitor the operating conditions of the weather sensors and related equipment components such as data logger, and it shall be capable to identify wheter failure is detected in each equipment component or not.

- The weather data server shall be capable to search compiled data, and searched result shall be capable to be displayed on the screen.

- The weather data server shall be capable to record the compiled data to the external storage device.

12.2 Structure

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

12.3 Performance (including Reliability)

- The Weather data server shall be capable enough to perform necessary functions stipulated in item 6.12.1.

- The weather data server shall be synchronized with all data loggers

12.4 Human Machine Interfaces

- If the observed weather data exceeds the threshold, the fact shall be notified to the operator with human mashine interface such as buzzer or appropriate screen display.

- The weather data server shall be equipped necessary human mashine interface such as monitor screen, key board and mouse.

12.5 Communication Interfaces

- The Weather Data Server shall be equipped necessary interface such as Ethernet interface to be connected to the network of Main Center.

12.6 Installation

- Weather Data Server shall be installed in air conditioned room in Main Center building.

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

13. Ambient Conditions

- In case the equipment component such as data logger is to be installed at outside, it shall be installed in the cabinet or chassis of IP65 or equivalent in order to secure the 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.

14. Power supply

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

15. Maintainability (including Spares / Consumables)

- 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 in case it is detected, and the faulty parts shall be replacable.

- The spare parts of weather monitoring equipment components and related system shall be available at least five (5) years after the equipment components are handed over to the road management authority, and the supply period of the spare parts shall be guaranteed by the manufacturer.

- The manufacturer of the weather monitoring equipment components and related system shall submit the necessary documents required for the operation and maintenance such as manuals and check list, and provide necessary training to Operation and Maintenance staffs of the related equipment components.

- The manufacturer/supplier of the weather monitoring equipment components and related system 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/supplier shall provide the necessary services based on the contract.

16. 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.

- The weather observation sensors shall be verified before delivery, and the contractor/manufacturer shall be delived with certificate of verification.

- The manufacturer shall be required to have some similar experiences of developing software for Weather Dafta Server specified above, and the manufacturer shall be required to submit the copy of the evidenced document of the successful delivery such as certificate of completion issued by the client attached with tender or prequalification proposal. In addition, several screen image of the delivered software shall be also submitted with the list of similar project experience attached with the tender or prequalification proposal.

17. Testing/Inspection for Weather Monitoring System

1) General

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

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

- There are two types of test such as factory test and connection test of weather monitoring system. The connection test includes weather sensors, weather data server, and related equipment components.

- As for the inspection, the connection inspection is to be witnessed basically.

- Tests and Inspection shall be executed and demonstrated by the contractor, manufacturer and/or the company in charge of installation work, and all necessary cost related to the tests and inspections shall be born by the contractor, manufacturer, and/or the company in charge of installation work.
- Test and inspection shall include the inventory check, visual inspection, and

performance test at least, respectively.

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

(1) The manufacturer's factory own test procedure shall be submitted to the road management authority and the consultant for approval
(2) After the factory test procedure is approved, the factory test shall be executed by the manufacturer, and the result shall be submitted to the road management authority and the consultant.
(3) Both connection test and its inspection procedure shall be submitted to the road management authority and the consultant
(4) After approval of the connection test procedure, the contractor's own connection test shall be executed and the test result shall be submitted to the road management authority and the consultant
(5) After approval of the inspection procedure, the inspection for the system connection shall be implemented witnessed by the road management authority and the consultant

3) Necessary Document

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

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

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

4) Other Conditions

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

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

DRAFT GENERAL SPECIFICATIONS (7)

Traffic Event Data Management

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following Documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

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

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

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Traffic Event:** An unusual event that affects or impedes the normal flow of traffic, which can be categorized to incident, traffic congestion, significant weather, construction work and traffic regulation.
- **Main Center:** The Center in charge of traffic monitoring, traffic control and traffic information dissemination, and is to be cooperated with road management offices.
- **Road Management Office:** An office in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring equipment for surveillance.
- **Junction:** A location on an expressway network where traffic can change between different travelling routes or directions. That comprises grade separation and ramps to permit traffic on the expressways to pass through the junction without directly crossing any other traffic stream.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.

- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Subsystem:** An element of the system architecture defined by considering function, location and envisioned operating body, which can be broken down to the lower-levels.
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Message:** A set of data to be exchanged between subsystems for transferring information.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **Traffic Analysis:** This functional package allows the road operators to keep track of traffic conditions on the expressways, such as crowdedness and vehicle velocity, by processing and analyzing the data captured by vehicle detectors.
- **Weather Monitoring:** 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.
- **Traffic Event Data Management:** 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.
- **Traffic Supervision:** This functional package allows the road operators at the Main Center and road management office to supervise totally and visually the current traffic conditions on the expressways and the information organized as traffic events
- **Mobile Radio Communication:** This functional package allows the road operators to exchange information between road operation vehicles/workers on the expressway and the road management office by using radio communication.
- **Traffic Information:** This functional package allows the road operators to provide other organizations with the information organized as traffic events on the expressways by using

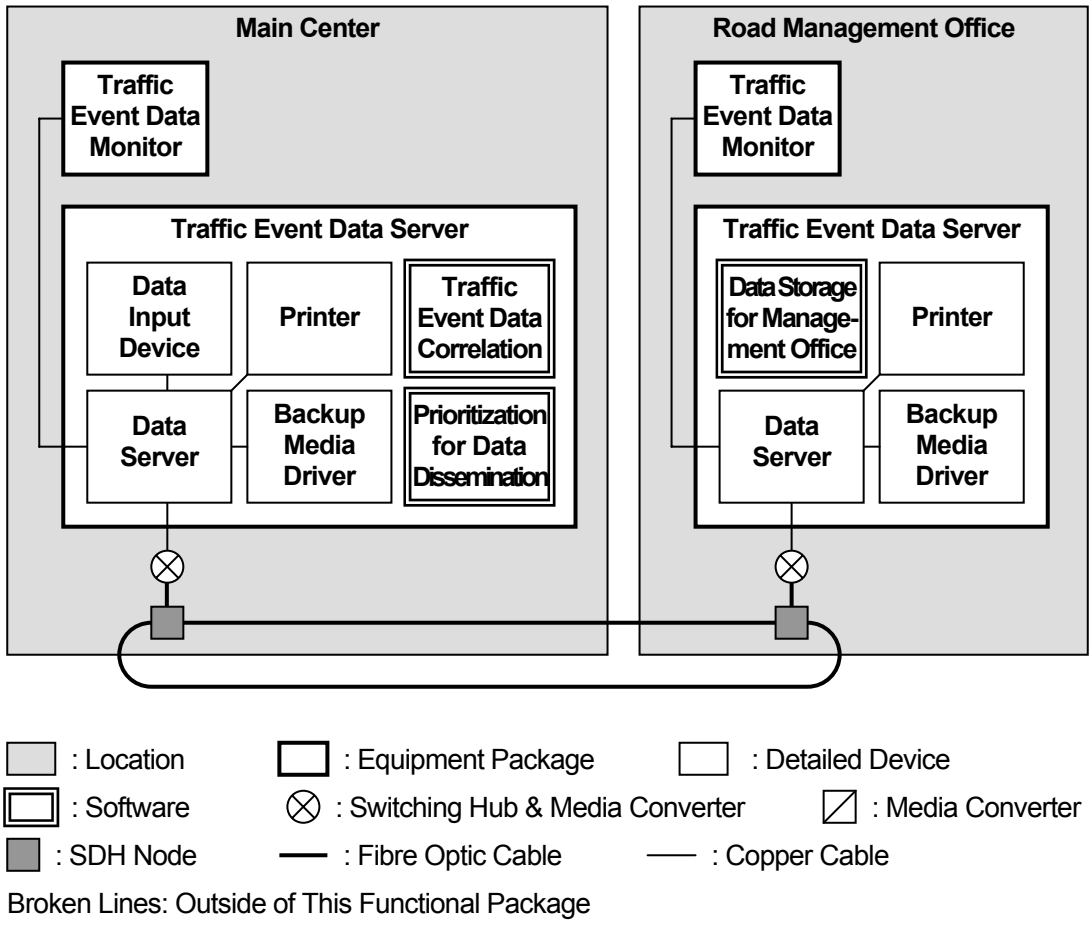
the Internet.

- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **Weather Sensor:** A sensor installed at a specific point on the road for measuring rainfall, wind speed, visibility, air temperature and road surface temperature.
- **VMS:** Variable Message Sign, which is an electronic sign installed along or above expressway and other highways that provide dynamic messages to alert the motoring public of incidents, congestion, construction, or other information. VMS is also known-as Changeable Message Sign and Dynamic Message Sign.
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.

5. Requirements

- System shall be capable of categorizing the results of CCTV monitoring, event detection, traffic analysis and weather monitoring, information from the drivers and other input information into adequate types, such as traffic accidents, breakdown vehicles, left obstacles, congestion levels, driving in the reverse direction, vandalism, significant weather and natural disaster.
- System shall be capable of inputting and categorizing the traffic regulations issued from the Main Center and road management office into adequate types such as speed restrictions, in-coming restrictions and closure.
- System shall be capable of identifying the categorized events by time and place.
- System shall be capable of conducting correlation and prioritization among the categorized events.
- System shall be capable of indicating the categorized events in Vietnamese, English and Chinese.
- System shall be capable of storing the categorized events 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 functioning 24 hours a day, 365 days a year by a redundant system and sufficient durability/reliability of equipment components.

6. System Architecture



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

7.1 Functions

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

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against lightning.
- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.
- The chassis of equipment components shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with the measures against interference from other electronic devices.

7.3 Performance

- Software shall be capable of automatically assigning serial number into Data Server by the order corresponding to the storing time of traffic event data which is obtained by Event Detection, Traffic Analysis and Weather Sensors.
- Software shall be capable of generating the “Correlated Traffic Event Data” that have a cause-and-effect relationship based on the input conditions from Traffic Supervision, and shall be capable of storing them in Data Server.
- Software shall be capable of releasing the relationship of the Correlated Traffic Event Data after completion of it, based on the input conditions from Traffic Supervision.
- Software shall be capable of inputting and editing an attribution of the Correlated Traffic Event Data, such as serial number, place, time and date, event types and serial number of preceding event, by Traffic Information Operator through the Data Input Device.
- Software shall be capable of defining the Correlated Traffic Event Data with its attribution of serial number, place, time & date, event types, serial number of correlated preceding event.
- Software shall be capable of defining and categorizing the 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 event are shown below;

- The traffic accident means property damage accidents, injury or death caused by accident, and multiple impact accident.
- The breakdown vehicle means puncture, out of gas, engine failure and car fire.
- The left obstacle means clutter on road such as cargo, corrugated board, lumber, vehicle part, oil and liquid. .
- The congestion condition means so identified result of traffic analysis.
- The vandalism means road damage caused by vandalization.
- The bad weather means strong wind, thick fog, and heavy rainfall.
- The natural disaster means disasters caused by earthquake, flood, roadside fire, falling rock, landslide, power failure, and lightning strike, etc.
- The traffic regulation means closure, in-coming restriction, speed restriction and lane restriction.

- Software shall be capable of defining the place of event by road section and kilometre signpost.
- Software shall be capable of defining the time and date of the event by year, month, date, hour, minute.
- Software shall be capable of running the backup of Data Server at the time and date which are set up in advance.
- Software shall be capable of retrieving the Correlated Traffic Event Data that is stored in Data Server by place and time and shall be capable of printing out the results of retrieval.

7.4 Human Machine Interface

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

7.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

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

7.6 Installation

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

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

8.1 Functions

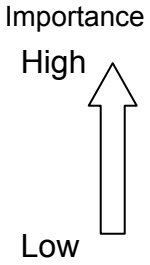
- Software shall be capable of prioritizing and categorizing the Correlated Traffic Event Data.
- Software shall be capable of generating and categorizing the message data to indicate VMS and SGM based on the prioritized Correlated Traffic Event Data.

8.2 Structure

8.3 Performance

- Software shall be capable of prioritizing information on traffic events to be disseminated by the importance and the place of the event occurrence.
- Software shall be capable of determining prioritizing traffic events based on the importance and cause of the event information to be disseminated.
  - Importance of the event information to be disseminated shall be defined in the order of closure, in-coming restriction, congestion, lane restriction, speed restriction, and others.

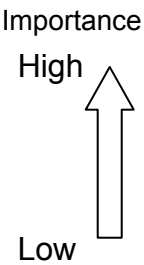
Table- 1 Importance of the Event Information to be disseminated



Event Information
Closure
In-coming restriction
Congestion
Lane restriction
Speed restriction
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.

Table- 2 Importance of the Cause of the Event



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

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

General rule

The nearest place

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

8.4 Human Machine Interface

- Software shall have the human machine interface in order to display messages of each position and messages of each time on the screen.
- Software shall have the human machine interface in order for the operator to input the necessary command.

8.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

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

8.6 Installation

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

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

9.1 Functions

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

9.2 Structure

9.3 Performance

- Software shall be capable of storing the transmitted traffic event data and message data from Traffic Event Data Server at Main Center and shall be capable of compiling it in a database.
- Software shall be capable of displaying the traffic event data and message data on the monitor and shall be capable of printing out data.
- Software shall be capable of running the backup of Data Server at the followed time and date.

9.4 Human Machine Interface

- Software shall have the human machine interface in order for the operator to display traffic event data and message data on the screen and to print it out.

9.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

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

9.6 Installation

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

10. Data Server

10.1 Functions

- The Data Sever in the Main Center shall be capable of categorizing the traffic event data in accordance with the attribution of the place of it, and shall be transmitted the copy of it to the Data Server in the related Road Management Office automatically.
- The Data Sever in the Main Center shall be capable of categorizing the message data in accordance with the attribution of the place of it, and transmitting the copy of it to the Data Server in the related Road Management Office automatically.
- The Data Server shall be capable of making backup of the stored data.

10.2 Structure

- The equipment shall be installed in the office and protected with the measures against typhoon, fire, earthquake, and other natural hazards.
- The equipment shall be capable of be installed in the office with sufficient working space.

10.3 Performance

- The Data Server shall have disk capacity for the traffic event data and the message data of at least one year.
- Software shall be capable of running the backup of Data Server at the time and date which are set up in advance
- The Data Server shall be capable of running a restoration of backup data.
- The Data Server shall be capable of equipping redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).

10.4 Human Machine Interface

- The equipment shall have the human machine interface in order for the operator to input the necessary command.

10.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

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

10.6 Installation

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

11. Traffic Event Data Monitor

11.1 Functions

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

11.2 Structure

- The equipment component shall be installed in the office and protected with the measures against typhoon, fire, earthquake, and other natural hazards.
- The equipment shall be capable of being installed in the office, having sufficient working space.

11.3 Performance

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

11.4 Human Machine Interface

- The equipment shall have the human machine interface for the operator to input the necessary command.

11.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

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

11.6 Installation

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

12. Ambient Conditions

- The equipment component shall be installed in the office and shall be protected with the measures against interferences of other electronic devices.
- The equipment component shall be capable of normally operating in ambient conditions. Ambient conditions are as follow:

	Temperature	Relative Humidity
The Main Center	25 +/- 3 degrees C.	20 – 80 %
The Road Management Office		

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

13. Power Supply

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

14. Maintainability

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

15. 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.

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

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

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

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

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

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

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

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

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management

authority and the consultant for approval in the appropriate timing before commencement of the tests and inspections, respectively in hard copy including followings;

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission document

DRAFT GENERAL SPECIFICATIONS (8)

Traffic Supervision

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following Documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

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

2. Scope

This Draft General Specifications deal with the equipment components and software to be installed in the Main Centers 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

4. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Traffic Event:** An unusual event that affects or impedes the normal flow of traffic, which can be categorized to incident, traffic congestion, significant weather, construction work and traffic regulation.
- **Main Center:** The Center in charge of traffic monitoring, traffic control and traffic information dissemination, and is to be cooperated with road management offices.
- **Road Management Office:** An office in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring equipment for surveillance.
- **Interchange:** A junction connecting an expressway network and an arterial road network. That comprises grade separation and ramps to permit traffic on the expressway to pass through the junction without directly crossing other traffic on the arterial road.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Subsystem:** An element of the system architecture defined by considering function, location

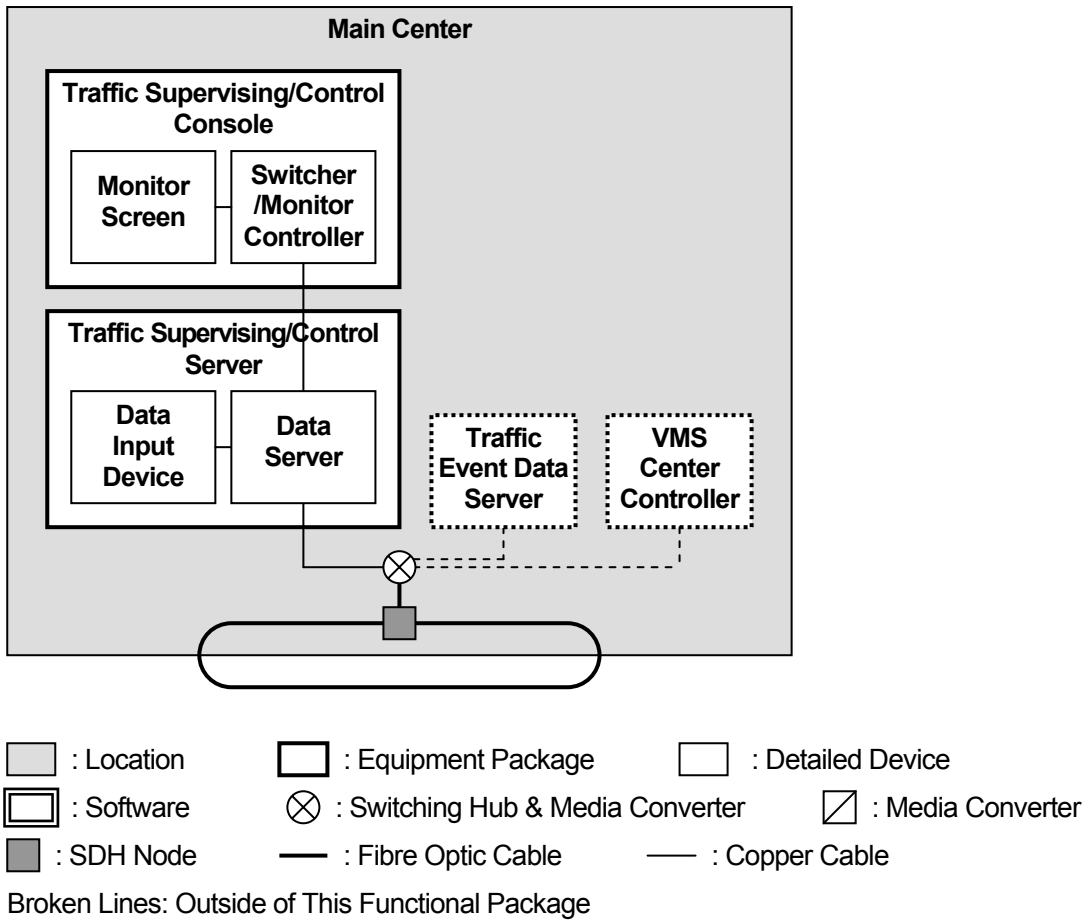
and envisioned operating body, which can be broken down to the lower-levels.

- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Message:** A set of data to be exchanged between subsystems for transferring information.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **Traffic Supervision:** This functional package allows the road operators at the Main Center and road management office to supervise totally and visually the current traffic conditions on the expressways and the information organized as traffic events
- **Traffic Information:** This functional package allows the road operators to provide other organizations with the information organized as traffic events on the expressways by using the Internet.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **VMS:** Variable Message Sign, which is an electronic sign installed along or above expressway and other highways that provide dynamic messages to alert the motoring public of incidents, congestion, construction, or other information. VMS is also known-as Changeable Message Sign and Dynamic Message Sign.
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.

5. Requirements

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

6. System Architecture



7. Traffic Supervising/Control Server (Display of Normal Operation and Data Conversion)

7.1 Functions

- Software shall be capable of describing total expressway network on the combined display, and shall be capable of displaying all toll gates and interchanges on the displayed expressways corresponding to the real location. The VMS, SGM, and CSS also shall be displayed on the expressways corresponding to the real position on the combined screen, with function of displaying the disseminating information.
- Software shall be capable of sectionalizing on 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 different colour for each MEMS on the combined screen.
- Software shall be capable of converting the data for indicating on the combined screen visually into the traffic event data and the message data that is stored in the Traffic Event Data Server.
- Software shall be capable of 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 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.
- The equipment components shall be protected with the measures against lightning.
- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.
- The chassis of equipment components shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.
- The equipment components shall be protected with the measures against interference from other electronic devices.

7.3 Performance

- Software shall be capable of converting the traffic event data to event position data on the event occurrence position of the expressways, which is to be displayed based on the coordinates on the combined screens, and also converting it to colour data indicating traffic event types automatically. The traffic event data is stored in the Traffic Event Data Server, and in order to convert it when the event is detected, the software shall be capable of retrieving it from the Traffic Event Data Server and capable of

displaying it on the combined display.

- Software shall be capable of converting the message data, which is stored in the Traffic Event Data Server, to the colour data indicating the disseminating status of the message of the corresponding VMS described on the combined screen.
- Software shall be capable of correlating of different several traffic events' data on the combined screens by mouse operation or selection of pulldowan menu to be developed as hierarchical structure.
- Software shall be capable of pointing and selecting the specific VMS described on the combined screen by mouse operation, and capable of selecting the providing message through it by selection of pulldowan menu to be developed as hierarchical structure.

- Software shall be capable of inputting and editing the attribute of traffic event data such as event type, place, time, message disseminating place, disseminating message contents by the Traffic Information Operator through the Data Input Device. Edited data by Traffic Information Operator shall be capable of stored into Traffic Event Data Server.

7.4 Human Machine Interface

- The equipment shall have the human machine interface for Traffic Information operator to input the necessary command.

7.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

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

7.6 Installation

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

8. Data Server

8.1 Functions

- The Data Server shall be capable of retrieving the traffic event data from the Traffic Event Data Server, and capable of converting the coordinates of the attribute of the position of the event data so as to indicate it on the proper position of the combined screen, and capable of storing the converted data with its attribute into the Data Server for necessary period.
- The Data Sever shall be capable of storing the converted coordinate data and colour data.
- The Data Server shall be capable of making backup of the stored data.

8.2 Structure

- The equipment components of Data Server shall be installed in the office and protected with the measures against typhoon, fire, earthquake, and other natural hazards.
- The equipment components of Data Server shall be capable of installing in the office having sufficient working space.

8.3 Performance

- The Data Server shall have disk capacity for storing coordinate data and colour data of at least one year.
- Backup of the stored data in the Data Server shall be capable of executing on the date which is set up in advance.
- The Data Server shall be capable of running a restoration of backup data.
- The Data Server shall have redundancy for the main components such as CPU (Central Processing Unit), Memory and HDD (Hard Disk Drive).

8.4 Human Machine Interface

- The equipment shall have the human machine interface for the operator to input the necessary command to the system.

8.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

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

8.6 Installation

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

9. Traffic Supervising/Control Console (Monitor Screen and Switcher/Monitor Controller)

9.1 Functions

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

9.2 Structure

- The equipment components shall be installed in the office and protected with the measures against typhoon, fire, earthquake, and other natural hazards.
- The equipment components shall be installed in the office having sufficient working space.

9.3 Performance

- The equipment shall be capable of composing several displays into one combined large screen display. The one display size shall be 60 inches or more.

Figure-1 Image of combined large Screen

60inch or more	60inch or more	60inch or more	60inch or more
60inch or more	60inch or more	60inch or more	60inch or more
60inch or more	60inch or more	60inch or more	60inch or more

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

9.4 Human Machine Interface

- The equipment shall have the human machine interface for the Traffic Info Operator to input the necessary command.
- The equipment shall have user-friendly interface for the Traffic Info Operator.

9.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

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

9.6 Installation

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

10. Ambient Conditions

- The equipment component shall be installed in the office and protected from interferences of other electronic devices.
- The equipment component shall be capable of normally operating in ambient conditions. The ambient conditions are as follows:

	Temperature	Relative Humidity
The Main Center	25 +/- 3 degrees C.	20 – 80 %

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

11. Power Supply

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

12. Maintainability

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

13. 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.

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

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

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

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

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

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

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

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

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

3) Necessary Document

All procedures of the tests and the inspections shall be submitted to the road management

authority and the consultant for approval in the appropriate timing before commencement of the tests and inspections, respectively in hard copy including followings;

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission document

DRAFT GENERAL SPECIFICATIONS (9)

VMS Indication

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following Documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

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1. General Outlines

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

2. Scope

This Draft General Specifications deal with the equipment components and software to be installed at roadside on the expressway network throughout Vietnam, including access sections of arterial roads, and in the Main Centers 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
- IEC 60529: Degrees of Protection provided by Enclosure (IP Code)

- 22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC

4. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Traffic Event:** An unusual event that affects or impedes the normal flow of traffic, which can be categorized to incident, traffic congestion, significant weather, construction work and traffic regulation.
- **Interchange:** A junction connecting an expressway network and an arterial road network. That comprises grade separation and ramps to permit traffic on the expressway to pass through the junction without directly crossing other traffic on the arterial road.
- **Junction:** A location on an expressway network where traffic can change between different travelling routes or directions. That comprises grade separation and ramps to permit traffic on the expressways to pass through the junction without directly crossing any other traffic stream.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.

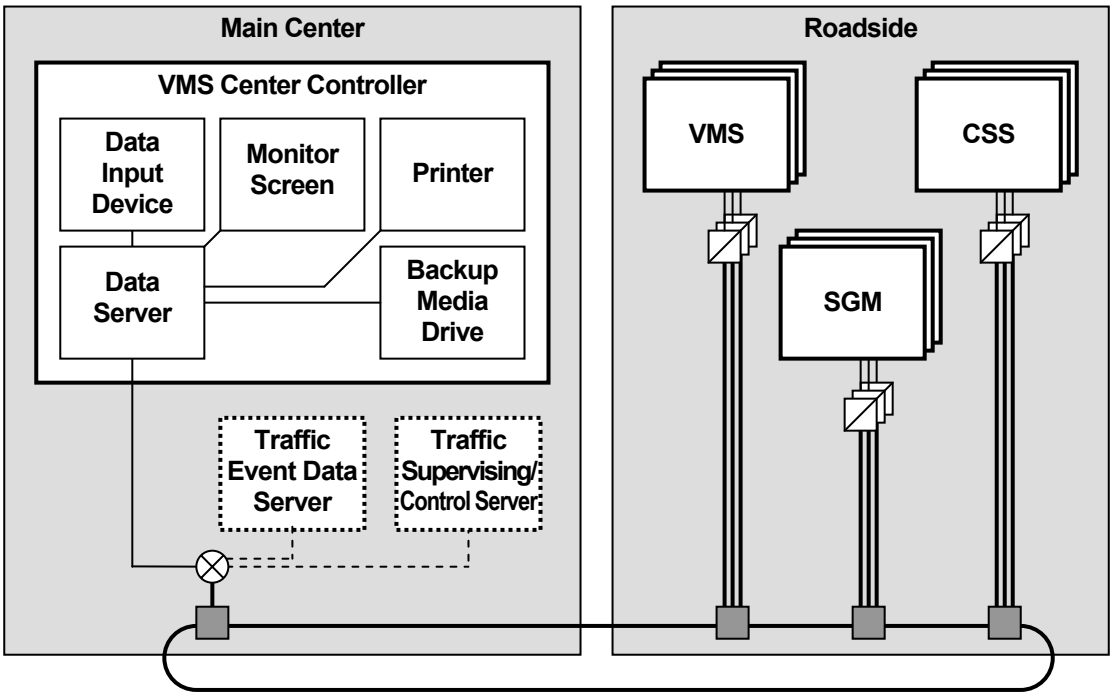
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Message:** A set of data to be exchanged between subsystems for transferring information.
- **Data Set:** A set of data elements included in a message with a strong relationship among them.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **Traffic Event Data Management:** 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.
- **VMS Indication:** This functional package allows the road operators to provide road users on the expressways with the information organized as traffic events by using VMS (Variable Message Sign) installed at the place short of entrances, exits, tollgates, junctions and tunnels.
- **Traffic Information:** This functional package allows the road operators to provide other organizations with the information organized as traffic events on the expressways by using the Internet.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **VMS:** Variable Message Sign, which is an electronic sign installed along or above expressway and other highways that provide dynamic messages to alert the motoring public of incidents, congestion, construction, or other information. VMS is also known-as Changeable Message Sign and Dynamic Message Sign.

- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.

5. Requirements

- System shall be capable of disseminating the information categorized/stored by traffic event data management in the forms appropriate for their types, such as traffic accidents, breakdown vehicles, left obstacles, driving in the reverse direction, vandalism, significant weather and natural disaster, at the equipment components on ~~at~~ roadside.
- System shall be capable of intervening in information dissemination by the operators based on their estimation.
- System shall be capable of indicating information in Vietnamese and English.
- System shall be capable of indicating text information for the drivers to read it visually on the vehicles with the maximum speed 120km/h.
- System shall be capable of updating the indicated information every 5 minutes.
- System shall be capable of indicating and printing out the needed results.
- System shall be capable of installing roadside equipment adequately at the place short of interchanges, entrances, exits, tollgates, junctions and tunnels on the expressways.
- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at installation site on roadside.

6. System Architecture



: Location : Equipment Package : Detailed Device

: Software : Switching Hub & Media Converter : Media Converter

: SDH Node : Fibre Optic Cable : Copper Cable

Broken Lines: Outside of This Functional Package

7. VMS (Variable Massage Sign)

7.1 Functions

- Equipment components shall be capable of disseminating information, generated from VMS Indication Data Set (such as breakdown of vehicle, traffic accidents, left obstacles, natural disasters, rainfall, big wind, fog and other occurrences) which transmitted from "Traffic Event 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.

- After operation recovery from the power failure, the system shall be capable of automatically displaying the information as disseminated before power failure.

- The equipment components shall be capable of providing full-colour display (*selective*)

- The equipment components shall be capable of providing multi-colour display (*selective*)

- The equipment components shall be capable of providing mono-colour display (*selective*)

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall have adequate structure for performing maintenance works from the its side and back, but not from lane direction, in order to minimize the influence to traffic activities.

- Chassis of equipment shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.

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

7.3 Performance

- The height of displayed letters shall be more than 450 mm
- The width of displayed letter shall be 16-86% of letter height (72-387 mm).
- The line thickness of the displayed letter shall be 10-20% of letter height (45-80mm).

Table 1 Specification of Letter height, Letter width, Line thickness

Letter height	Letter width	line thickness
450mm 以上 >450mm	16-86% of letter height （72-387mm）	10-20% of letter height (45-80mm)

Table 2 Letter width of alphabet

	Letter width (mm)							
	22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC						For VMS	
Letter height (mm)	200	Ratio to Letter Height	300	Ratio to Letter Height	400	Ratio to Letter Height	450	Ratio to Letter Height
A, Â	170	85%	225	75%	340	85%	378	84%
B	137	69%	205	68%	274	69%	306	68%
C	137	69%	205	68%	274	69%	306	68%
D	137	69%	205	68%	274	69%	306	68%
Đ	155	78%	232	77%	310	78%	342	76%
E, Ê	124	62%	186	62%	248	62%	279	62%
F	124	62%	186	62%	248	62%	279	62%
G	137	69%	205	68%	274	69%	306	68%
H	137	69%	205	68%	274	69%	306	68%
I	32	16%	48	16%	64	16%	72	16%
J	127	64%	190	63%	254	64%	279	62%
K	140	70%	210	70%	280	70%	315	70%
L	124	62%	186	62%	248	62%	279	62%
M	157	79%	236	79%	314	79%	351	78%
N	137	69%	205	68%	274	69%	306	68%
O, Ô, Ơ	143	72%	214	71%	286	72%	315	70%
P	137	69%	205	68%	274	69%	306	68%
Q	143	72%	214	71%	286	72%	315	70%
R	137	69%	205	68%	274	69%	306	68%
S	137	69%	205	68%	274	69%	306	68%
T	124	62%	186	62%	248	62%	279	62%
U	137	69%	205	68%	274	69%	306	68%
Ư	167	84%	250	83%	334	84%	378	84%
V	152	76%	229	76%	304	76%	342	76%
X	137	69%	205	68%	274	69%	306	68%
Y	171	86%	257	86%	342	86%	387	86%
Z	137	69%	205	68%	274	69%	306	68%
Average	133	67%	198	66%	267	67%	297	68%

Table 3 Letter width of number

	Letter width (mm)							
	22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC						For VMS	
Letter height (mm)	200	Ratio to Letter Height	300	Ratio to Letter Height	400	Ratio to Letter Height	450	Ratio to Letter Height
1	50	25%	74	25%	98	25%	108	24%
2	137	69%	205	68%	274	69%	306	68%
3	137	69%	205	68%	274	69%	306	68%
4	149	75%	224	75%	298	75%	306	68%
5	137	69%	205	68%	274	69%	306	68%
6	137	69%	205	68%	274	69%	306	68%
7	137	69%	205	68%	274	69%	306	68%
8	137	69%	205	68%	274	69%	306	68%
9	137	69%	205	68%	274	69%	306	68%
0	143	72%	214	71%	286	72%	324	72%
Average	130	65%	195	65%	260	65%	288	64%

- One displayed row shall not have more than 24 letters.
- LED shall be used for displaying panel, concerning its durability and light intensity.
- The equipment components shall be capable of displaying in Vietnamese and English languages.
- Display font shall be in accordance with 22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC.
- System is capable of showing alternative display by controlling from VMS Centre Controller.
- The display shall be capable of being switched in less than 0.5 seconds, and of displaying each information during 1 to 10 seconds (depending on requirement).
- The equipment components shall have with control signal input interface for trial display when setting up on installation site.
- The equipment components shall have interface for inputting display information directly on VMS in case of emergency.
- The equipment components shall be capable of having adequate visual performance with bias angle of +/-10 degrees from the perpendicular to display panel.
- When displaying letters, the letters shall be displayed by shifting left-right, and top-bottom,

30mm for each shifting time, at certain time interval equalizing with lighting frequency of LED elements. Picture display is exception.

- Dot intervals of LED elements shall be less than 20 mm.

- The luminance of each display colour in operation in daytime is shown in Table below;

Table 4 Luminance of each display colour in operation of daytime

Display colour	Operation luminance
Blue	500cd/㎡ or more
Red	1600cd/㎡ or more
Green	2200cd/㎡ or more
White	4300cd/㎡ or more
Yellow	3800cd/㎡ or more
Cyan	2700cd/㎡ or more
Orange	2500cd/㎡ or more

- The luminance of each display colour in operation in nighttimes is shown in Table below;

Table 5 Luminance of each display colour in operation of nighttimes

Display colour	Operation luminance
Blue	25cd/㎡ or more
Red	85cd/㎡ or more
Green	120cd/㎡ or more
White	230cd/㎡ or more
Yellow	205cd/㎡ or more
Cyan	145cd/㎡ 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.

- System shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

- The equipment components shall be capable of sending a signal to VMS Center Controller in case of power failure.

- The equipment component shall be selected due to availability of supplying the Device Driver for controlling display of the equipment component. The equipment component shall be supported with interface of “VMS Center Controller”, if possible.

Table 6 VMS Structure Type

Location	Specification
Short of the entrance	- Display type: multi-colour LED - Number of row : 3 rows - Number of column : 24 columns/row - Colour: Red, Orange, Light green - Dots: 43,225 dots - Resolution: 95(h) x 455(w) pixels
Short of junction	- Display type: multi-colour LED - Number of row : 2 rows - Number of column : 24 columns/row - Colour: Red, Orange, Light green - Dots: 28,665 dots - Resolution: 63(h) x 455(w) pixels
Short of the exit	- Display type: multi-colour LED - Number of row : 2 rows - Number of column : 24 columns/row - Colour: Red, Orange, Light green - Dots: 28,665 dots - Resolution: 63(h) x 455(w) pixels
Short of the tollgate	- Display type: multi-colour LED - Number of row : 3 rows - Number of column : 24 columns/row - Colour: Red, Orange, Light green - Dots: 43,225 dots - Resolution: 95(h) x 455(w) pixels
Midway between two of interchanges	- Display type: multi-colour LED - Number of row : 3 rows - Number of column : 24 columns/row - Colour: Red, Orange, Light green - Dots: 43,225 dots - Resolution: 95(h) x 455(w) pixels

Figure 1 Text Arrangement of VMS

24 Texts x 2 Lines

24 Texts x 3 Lines

7.4 Human Machine Interface

- The equipment component shall have the human-machine interface for Traffic Information Operator to input the "VMS Indication Data Set" into the system.

- The equipment component shall have the control signal input interface to directly control the displayed information on VMS at the installation site when communication line interruption is happened.

7.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

- The system shall be capable of getting control signal from VMS Center Controller, then controlling LED device light to be on or off.

- Transmission devices shall have following interfaces;
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the interface standards

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

7.6 Installation

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

- The equipment components shall have adequate robustness against the wind of 60m/s speed or equivalent.

8. CSS (Changeable Speed Limit Sign)

8.1 Functions

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

- After operation recovery from the power failure, the system shall be capable of automatically displaying the information as disseminated before power failure.

- The system shall be capable of displaying in mono-colour.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment component shall be installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall have adequate structure for performing maintenance works from the it's side and back, but not from lane direction, in order to minimize the influence to traffic activities.

- Chassis of equipment shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.

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

- Dimension of CSS shall follow Vietnamese Standards on 22TCN237-01 Regulation on Road Signs.

- Diameter of CSS shall be 122.5cm.

8.3 Performance

- The height of displayed letters shall be more than 450 mm.
- The width of displayed letter shall be 24-72% of letter height (108-324 mm) as shown on Table 8.
- The line thickness of the displayed letter shall be 10-20% of letter height (45-80mm).

Table 7 Specification of Letter height, Letter width, Line thickness

Letter height	Letter width	line thickness
450mm 以上 >450mm	24-68% of letter height （108-324mm）	10-20% of letter height (45-80mm)

Table 8 Letter width of number

	Letter width (mm)							
	22TCN331-05 BIỂN CHỈ DẪN TRÊN ĐƯỜNG CAO TỐC						For VMS	
Letter height (mm)	200	Ratio to Letter Height	300	Ratio to Letter Height	400	Ratio to Letter Height	450	Ratio to Letter Height
1	50	25%	74	25%	98	25%	108	24%
2	137	69%	205	68%	274	69%	306	68%
3	137	69%	205	68%	274	69%	306	68%
4	149	75%	224	75%	298	75%	306	68%
5	137	69%	205	68%	274	69%	306	68%
6	137	69%	205	68%	274	69%	306	68%
7	137	69%	205	68%	274	69%	306	68%
8	137	69%	205	68%	274	69%	306	68%
9	137	69%	205	68%	274	69%	306	68%
0	143	72%	214	71%	286	72%	324	72%
Average	130	65%	195	65%	260	65%	288	64%

- CSS shall have only one letter row.
- One row shall not have more than 3 letters
- LED shall be used for displaying panel, considering its durability and light intensity.
- Only orange colour shall be used for LED.
- Form of literature is according to Vietnamese Standards on 22TCN237-01 Regulation on Road Sign.
- The equipment components shall be capable of sending a signal to VMS Center Controller in case of power failure.

- The system shall have control signal input interface for display trial when positioning CSS.

- The equipment components shall be capable of having adequate visual performance with bias angle of +/-10 degrees from the perpendicular to display panel.

- When displaying letters, the letters shall be displayed by shifting left-right, and top-bottom, 30mm for each shifting time, at certain time interval equalizing with lighting frequency of LED elements. Picture display is exception.

- Dot intervals of LED elements shall be less than 20 mm.

- The luminance of each display colour in operation in daytime is shown in Table below.

Table 9 Luminance of each display colour in operation of daytimes

Display colour	Operation luminance
Orange	2500cd/㎡ or more

- The luminance of each display colour in operation in nighttimes is shown in Table below

Table 10 Luminance of each display colour in operation of nighttimes

Display colour	Operation luminance
Orange	140cd/㎡ 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 system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

- The equipment shall be capable of sending a signal to VMS Center Controller in case of power failure.

- The equipment component shall be selected due to availability of supplying the Device Driver for controlling display of the equipment component. The equipment component shall be supported with interface of “VMS Center Controller”, if possible.

8.4 Human Machine Interface

- The equipment component shall have the human-machine interface for Traffic Information Operator to input the “VMS Indication Data Set” into the system.

- The equipment component shall have control signal input interface to directly control the displayed information on VMS at the installation site when communication line interruption is happened.

8.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

- The system shall be capable of getting control signal from VMS Center Controller, then control LED device light to be on or off.

- Transmission devices shall have following interfaces;
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the interface standards

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

8.6 Installation

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

- The equipment components shall have adequate robustness against the wind of 60m/s speed or equivalent.

9. VMS Center Controller

9.1 Functions

- The system shall be capable of acquiring the information currently displayed on VMS and CSS.

- The system shall be capable of allowing operating staff to make decision on information to be disseminated on VMS and CSS, based on the current displayed information and Traffic Event Data Set.

- The system shall be capable of synchronizing its clock to the clock of "Traffic Supervising / Control Server" at the start-up.

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

- The system shall be capable of generating a letter strings to be displayed on VMS based on the following information, which is received from "Traffic Event Data Server".

Table 11 VMS Indication Data Set from Traffic Event Data Server

Data Set	Data Elements	Definition
VMS Indication Data Set	Roadside Equipment ID	Roadside equipment identification number to be used to display on VMS.
	Date	A number indicating the date (year, month, date) to be displayed on VMS.
	Time	A number indicating the time (hour, minute, second) to be displayed on VMS.
	Traffic Event Class ID	Identification number of traffic event data
	Place Name ID	Identification number of the name of the place where traffic event occurred.
	Causal Traffic Event Class ID	Identification number of causal traffic event data
	Causal Place Name ID	Identification number of the name of the place where traffic event occurred

- The system shall be capable of generating a letter strings to be displayed on VMS, based on the following information which is inputted from "Data Input Device" of "VMS Data Controller".

Table 12 VMS Indication Data Set for Manual Input

Data Set	Data Elements	Definition
VMS Indication Data Set	Roadside Equipment ID	Roadside equipment identification number to be used to display on VMS.
	Date	Automatic input (correctable)
	Time	Automatic input (correctable)
	Mile stone of Traffic Event	Mile stone of the place where traffic event occurred.
	Traffic Event Class ID	Identification number of traffic event data
	Place Name ID	Identification number of the name of the place where traffic event occurred.
	Place Name	Name of the place where traffic event occurred.
	Mile stone of Causal Place Name	Mile stone of the place where causal traffic event occurred.
	Causal Traffic Event Class ID	Identification number of causal traffic event data
	Causal Place Name ID	Identification number of the name of the place where causal traffic event occurred.
	Causal Place Name	Name of the place where causal traffic event occurred.

- The system shall be capable of generating a letter string to be displayed on CSS, based on the following information which is sent from “Traffic Event Data Server”.

Table 13 CSS Indication Data Set from Traffic Event Data Server

Data Set	Data Elements	Definition
CSS Indication Data Set	Roadside Equipment ID	Roadside equipment identification number to be used to display on CSS.
	Date	A number indicating the date (year, month, date) to be displayed on CSS.
	Time	A number indicating the time (hour, minute, second) to be displayed on CSS.
	Traffic Event Class ID	Identification number of traffic event data
	Place Name ID	Identification number of the name of the place where traffic event occurred.
	Causal Traffic Event Class ID	Identification number of causal traffic event data
	Causal Place Name ID	Identification number of the name of the place where traffic event occurred

- The system shall be capable of generating a letter string to be displayed on CSS, based on the following information which is inputted from “Data Input Device” of “VMS Data Controller”.

Table 14 VMS Indication Data Set for Manual Input

Data Set	Data Elements	Definition
CSS Indication Data Set	Roadside Equipment ID	Roadside equipment identification number to be used to display on CSS.
	Date	Automatic input (correctable)
	Time	Automatic input (correctable)
	Mile stone of Traffic Event	Mile stone of the place where traffic event occurred.
	Traffic Event Class ID	Identification number of traffic event data
	Place Name ID	Identification number of the name of the place where traffic event occurred.
	Place Name	Name of the place where traffic event occurred.
	Mile stone of Causal Place Name	Mile stone of the place where causal traffic event occurred.
	Causal Traffic Event Class ID	Identification number of causal traffic event data
	Causal Place Name ID	Identification number of the name of the place where causal traffic event occurred.
	Causal Place Name	Name of the place where causal traffic event occurred.

9.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment components shall be installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

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

9.3 Performance

- The system shall be capable of sending a signal to control LED device of VMS in order to display generated letter strings on VMS.

- The system shall be capable of displaying on Monitor Screen the letter string which is being displayed on each VMS at the present moment.

- The system shall be capable of displaying on Monitor screen the list of VMS and the data

which is inputted in each VMS at the present moment.

- The system shall be capable of printing disseminated information which is displayed on Monitor Screen.

- The system shall be capable of storing letter strings which are displayed in each VMS and storing "VMS Indication Data Set" which generate letter strings, into a database.

- The system shall be capable of allowing the traffic information operator to input the "VMS Indication Data Set" into the system.

- The system shall be capable of extracting letter strings displayed on VMS and "VMS Indication Data Set" which is letter strings generating source from accumulated VMS database, based on searching conditions, which is inputted from Data Input Device, then displaying on Monitor Screen.

Table 15 Minimum Seeking Condition for Data Server

Data Elements	Definition
Roadside Equipment ID	Roadside equipment identification number to be used to display on VMS, CSS.
Date	A number indicating the date (year, month, date) to be displayed on VMS, CSS.
Time	A number indicating the time (hour, minute, second) to be displayed on VMS, CSS.
Mile stone of Traffic Event	Mile stone of the place where traffic event occurred.
Traffic Event Class ID	Identification number of traffic event data
Place Name ID	Identification number of the name of the place where traffic event occurred.
Place Name	Name of the place where traffic event occurred.

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

- "Data Server" shall have disk capacity for storing coordinate data and colour data for at least one year.

- "VMS Center Controller" shall have "Backup Media Drive" for Backup of the stored data in the Data Server.

- "Data Server" shall be capable of executing the backup of the stored data on the date which is set up in advance.

- "Data Server" shall be capable of running a restoration of backup data.

- "Data Server" shall have redundancy for the main components such as CPU (Central

Processing Unit), Memory and HDD (Hard Disk Drive).

- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

- The equipment components should be capable of sending a signal to VMS Center Controller in case of power failure.

9.4 Human Machine Interface

- The equipment component shall have the human-machine interface for the Traffic Information Operator to input necessary commands into the system.

- The system shall be capable of displaying generated letter string on monitor screen for confirmation.

9.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

- The transmission devices shall have followings interfaces;
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Bit transmission procedure
  - Data transmission procedure
  - Timing chart and other details of the interface standards

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

9.6 Installation

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

10. Ambient Conditions

- The equipment component shall be installed in the offices and protected with the measures against interferences of other electronic devices.

- The equipment component shall be capable of normally operating under the ambient conditions. The ambient conditions are shown in Table 8.

Table 16 Ambient Conditions

	Temperature	Relative Humidity
Main Center Toll Management Center Toll Office	Average 25 +/- 3 degrees C.	Average 20 – 80 %
Outside	-0 degrees C < < +50 degrees C	Average < 95%

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

11. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.

- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

12. Maintainability

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

- The equipment components shall be capable to identify the faulty parts easily in case it is detected, and the replacement of the parts shall be simple.

- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.

- The manufacturer of the equipment components shall submit the necessary documents necessary for the operation and maintenance such as manuals and check list, and necessary training shall be provided to the staffs to be work as O&M staffs of the related equipment components.

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

13. 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.

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

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

(2) After the factory test procedure is approved, the factory test shall be executed by the

manufacturer, and the result shall be submitted to the road management authority and the consultant.

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

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

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

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

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

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (10)

Mobile Radio Communication

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

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

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 road management offices of the expressway network for actualizing this functional package. 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.

Licencing fee and charge for utilization and other necessary cost shall be subject to the regulations of Radio Frequency Directorate

BS 7430: Earthing
BS 6651: Lightning Protection

4. Definitions of Terms

- **Incident:** An unusual and unplanned event that affects or impedes the normal flow of traffic, such as traffic accidents, broken-down vehicles, left obstacles, reversing vehicles, vandalism and natural disaster on the road.
- **Road Management Office:** An office in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring equipment for surveillance.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.

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

5. Requirements

- System shall be capable of receiving report of current traffic conditions on the expressways and of incident occure promptly from the operators in the toll office and the rest area.

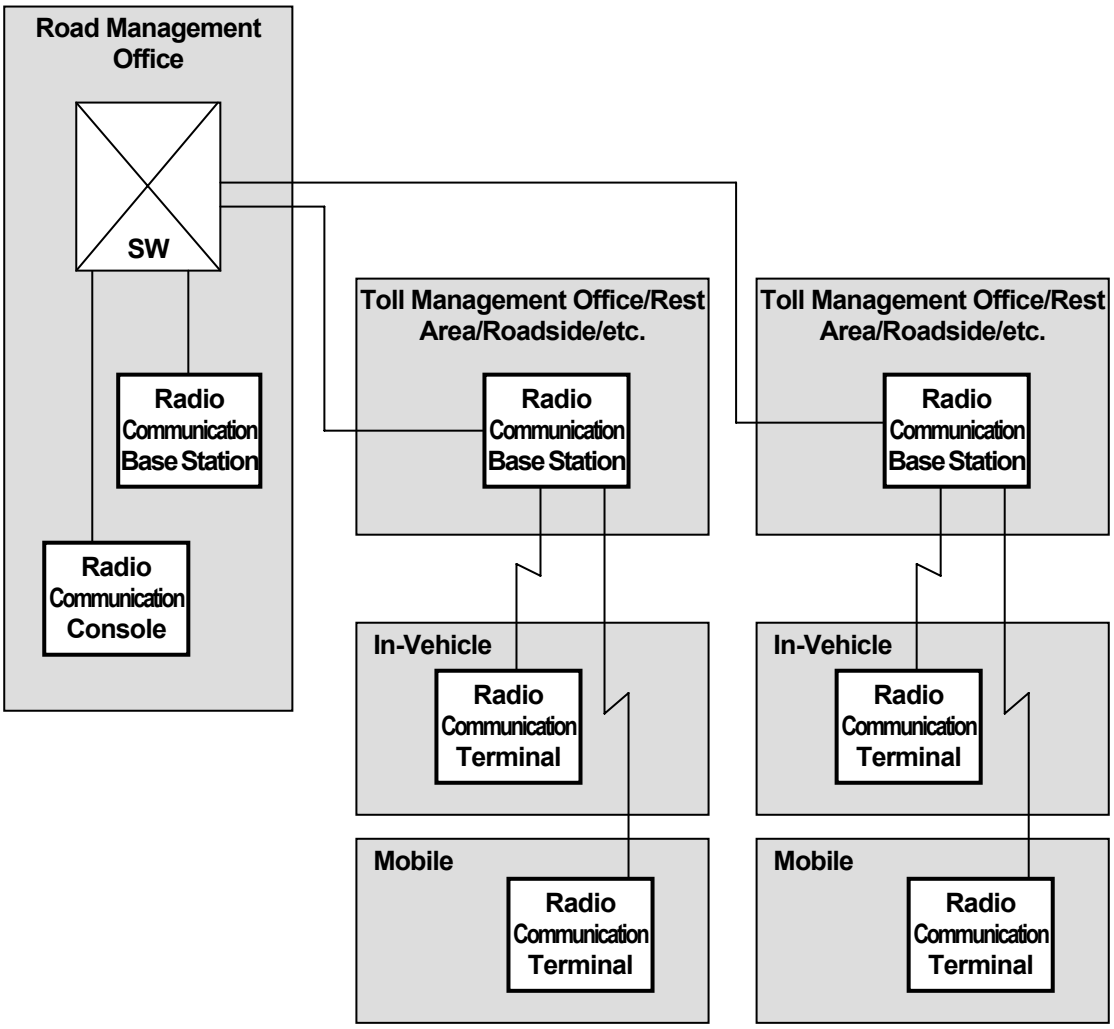
- System shall be capable of sending directive to the units concerned simultaneously for clearing incidents and enforcing traffic regulations.

- System shall be capable of receiving notification of incident occurrence within 20 minutes, and sending road operation vehicles to the incident site within 1 hour.

- System shall be capable of functioning 24 hours a day, 365 days a year by a redundant system and sufficient durability/reliability of equipment components.

- The license required for the system shall be obtained from Radio Frequency Directorate of Ministry of Information and communication, and necessary cost shall be disbursed.

6. System Architecture



7. Radio Communication Base Station

7.1 Functions

- The base station shall be capable to materialize interactive voice communication between Road Management Office and the terminal equipment component holders who belong to the Office.

- In emergency case when Road Management Office receives directive communication from Main Center, the directive communication shall be certainly transmitted to the terminal equipment component through the base station.

- The directive communication shall be capable to interrupt through the base station even though while the terminal holder communicates with another terminal holder within coverage area of its own terminal.

- The radio frequency band to be applied shall be VHF or UHF.

- The radio communication equipment component of base station shall be prepared back up electric power source so as to operate continuously even though during commercial power failure.

- The radio communication equipment components of base station shall be those types whose usefulness have been confirmed by the business users in foreign countries except for the original manufacturing country.

- The radio frequency and equipment components to be utilized in operation as base station shall be licensed by Radio Frequency Directorate of Ministry of Information and Communication.

7.2 Structure

- The radio communication equipment component shall have sufficient durability for 24hours a day, 365 days a year.

- The structure of radio communication equipment components shall be capable to replace the faulty parts simply and easily when it is detected.

7.3 Performance

- The interference problem should be avoided between adjacent expressways sections managed by different road management offices basically.

- The coverage area for interactive voice communication using radio communication equipment component shall be 100% of the objective expressway road section including tunnel section, Inter change, service area, rest area, parking area and all other

areas related to the expressway operation and maintenance.

7.4 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 be equipped necessary Human Machine Interface such as key board and screen.

7.5 Communication Interfaces

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

7.6 Installation

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

8. Radio Communication Console

8.1 Functions

- In emergency case when Road Management Office receives directive communication from Main Center, the radio communication console at Road Management Office shall be capable to transmit it to the terminal equipment component.

- The radio communication console shall be capable to select terminal equipment component(s) which is required to transmit the directive.

- The directive communication from the radio communication console to the terminal shall be capable to interrupt even though while the terminal holder communicates with another terminal holder within coverage area of its own terminal.

- The radio communication console equipment components shall be prepared back up electric power source so as to operate continuously even though during commercial power failure.

- The radio communication console equipment components shall be those types whose usefulness have been confirmed by the business users in foreign countries except for the original manufacturing country.

8.2 Structure

- The radio communication console equipment component shall have sufficient durability for 24hours a day, 365 days a year.

- The structure of radio communication console equipment components shall be capable to replace the faulty parts simply and easily when it is detected.

8.3 Performance

- The operator shall be clearly identifiable destination of directive communication on the radio communication console.

- The operator shall be clearly identifiable with indicator on the radio communication console whether terminal holder acknowledges the directive or not, after the operator transmits the directive.

8.4 Human Machine Interfaces

- The radio communication console at road management office shall be equipped necessary Human Machine Interfaces for transmitting directives, receiving acknowledges, and voice communications.

- The radio communication console at road management office shall be equipped human machine interface which is able to receive directive from the main center.

8.5 Communication Interfaces

- All of the interfaces of radio communication console equipment components to be installed in a road management office shall be compatible to other connecting radio communication equipment components and shall not be hindrance of its communication.

8.6 Installation

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

9. Radio Communication Terminal

9.1 Functions

- The radio communication terminal equipment component shall be equipped with

notification function of directive such as buzzer for the terminal holder when it receives the directive communication.

- The radio communication terminal equipment component shall be equipped response function of acknowledgement of the directive to the console in road management office after terminal holder acknowledges the directive communication.

- The directive communication shall be capable to interrupt and transmit directive to the terminal even though while the terminal holder communicates with another terminal holder within 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 those types whose usefulness have been confirmed by the business users in foreign countries except for the original manufacturing country.

- The radio frequency and radio communication terminal equipment to be utilized in operation shall be licensed by Radio Frequency Directorate of Ministry of Information and Communication.

9.2 Structure

- The radio communication terminal equipment component shall have sufficient durability for 24hours a day, 365 days a year.

- The structure of radio communication terminal equipment component shall be capable to replace the faulty parts simply and easily when it is detected.

9.3 Performance

- The radio communication terminal equipment component shall be operated simply.

- The radio communication terminal equipment component shall be capable to sound clearly so that the terminal holder is able to hear the voice easily under the noise conditions of expressway roadside.

9.4 Human Machine Interfaces

- The radio communication terminal equipment component shall be equipped with notification function of directive such as buzzer for the terminal holder when it receives the directive communication..

- The radio communication terminal equipment component shall be equipped response

function of acknowledgement of the directive to the console in road management office after terminal holder acknowledges the directive communication.

9.5 Communication Interfaces

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

10. Switching System for Radio Communication

10.1 Functions

- Functions for switching system for radio communication shall be refereed to the directive communication part of “General Specifications for Telephone”. The followings are additional functions related to the Mobile Radio Communication.

- The switching system for radio communication shall be capable to materialize interactive voice communication between Road Management Office and the terminal equipment component holders who belong to the Office.

- The directive communication from the console in Road Management Office shall be incoming call of the terminal equipment component through the switching system.

- The switching system shall be capable to select the destination of directive communication in accordance with the designation made by the operator of radio communication console in road management office.

- The directive communication shall be capable to interrupt even though while the terminal holder communicates with another terminal holder within coverage area of its own terminal.

10.2 Structure

- Structure for switching system for radio communication shall be refereed to the “General Specifications for Telephone”.

10.3 Performance

- The directive communication from the operator of console in road management office shall be connected to the terminal equipment component without any connection loss.

10.4 Human Machine Interfaces

- Human Machine Interface for switching system for radio communication shall be

refereed to the “General Specifications for Telephone”.

10.5 Communication Interfaces

- Communication interface for switching system for radio communication shall be refereed to the “General Specifications for Telephone”. The following is additional item related to the Mobile Radio Communication.

- All of the interfaces between switching system and other radio communication equipment components shall be compatible each other and shall not be hindrance of its interactive voice communication.

10.6 Installation

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

11. Ambient Conditions

- The radio communication equipment component to be installed in Road Management Office such as equipment components for console and radio transmission, shall be accommodated in the air conditioned clean room or chassis equivalent to IP66 to keep the performance of the equipment components.

- The terminal equipment component such as handset shall be protected with IP54 or equivalent.

- The equipment component to be installed outside shall be weather proof type of Vietnam and shall also be protected from damages caused by lightning.

- The spare parts of the radio communication equipment components shall be accommodated in proper conditions such as clean room or chassis to keep the proper performance of them. The accommodation conditions shall be subject to the individual equipment components requirements to the storage environment.

12. Power Supply

- The electric power supply for the equipment components of the base station and repeater station of the radio communication shall be equipped the back up power supply for securing the operation of the equipment components of it for 24 hours a day 365 days a year.

13. Maintainability

- The equipment components shall be maintained easily and simply
- The radio communication equipment components 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 radio communication equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.
- The manufacturer of the radio communication equipment components shall submit the necessary documents required for the operation and maintenance such as manuals and check list, and provide necessary training to Operation and Maintenance staffs of the related equipment components.
- The manufacturer/supplier of the radio communication 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/supplier shall provide the necessary services based on the contract

14. 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.

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

(2) There are three types of test such as factory test, unit test of the equipment component at site after installation, and connection test between console to be installed at road

management center and terminal equipment components, and between terminal equipment components. The coverage area test shall also be included in the connection test.

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

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

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

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

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

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (11)

Traffic Information

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

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

This Draft General Specifications deal with the equipment components and software to be installed in the Main Centers of the expressway network for actualizing this functional package.

3. Relevant Regulations and Standards

- ISO 14813-1:2007: Intelligent transport systems – Refernce model architecture(s) for the ITS sentor – Part 1: ITS service domains, service groups and services
- ISO/IEC 11179: Information technology – specification and standardization of data elements
- ISO/DIS 14817: Transport information and control systems – requirements for an ITS/TICS central data registry and ITS/TICS data dictionaries
- ISO/CD 24533: Data directory and Message set for tracking of freight and It's intermodal transfer
- ISO 14813-1:2007: Hệ thống giao thông thông minh – Tham khảo kiến trúc mẫu cho các phần ITS – Phần 1: miền dịch vụ ITS, nhóm dịch vụ và dịch vụ
- ISO/IEC 11179: Công nghệ thông tin – yêu cầu kỹ thuật và tiêu chuẩn hóa các nhân tố dữ liệu
- ISO/DIS 14817: Công nghệ thông tin và hệ thống điều khiển – yêu cầu đăng ký dữ liệu trung tâm ITS/TICS và từ điển dữ liệu ITS/TICS
- ISO/CD 24533: Thư mục dữ liệu và thông điệp để thiết lập theo dõi vận chuyển hàng hóa và vận chuyển liên hợp

4. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Traffic Information/Control:** An ITS user service for providing accurate surveillance of traffic conditions on the roads, assisting prompt action of the road operator and emergency vehicles by notifying occurrences of traffic accidents, significant weathers and traffic congestions, allowing the road operator to control road traffic and the drivers to avoid the influence of the incidents by providing accurately updated information.
- **Incident:** An unusual and unplanned event that affects or impedes the normal flow of traffic, such as traffic accidents, broken-down vehicles, left obstacles, reversing vehicles, vandalism and natural disaster on the road.
- **Traffic Restriction:** A limitation on the road transport, such as closure, lane restriction, speed restriction and warning information.

- **Traffic Event:** An unusual event that affects or impedes the normal flow of traffic, which can be categorized to incident, traffic congestion, significant weather, construction work and traffic regulation.
- **Vehicle Class:** A set of categories of vehicles for toll collection, traffic data or overloading regulation with definition of unique name/identifier to be applied to each category.
- **Main Center:** The Center in charge of traffic monitoring, traffic control and traffic information dissemination, and is to be cooperated with road management offices.
- **Road Management Office:** An office in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring equipment for surveillance.
- **Toll Office:** A toll office is located at a tollgate, which includes two or more tollbooths, and is in charge of toll collection.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Traffic Event Data Management:** 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.
- **Traffic Supervision:** This functional package allows the road operators at the Main Center and road management office to supervise totally and visually the current traffic conditions on the expressways and the information organized as traffic events
- **Traffic Information:** This functional package allows the road operators to provide other

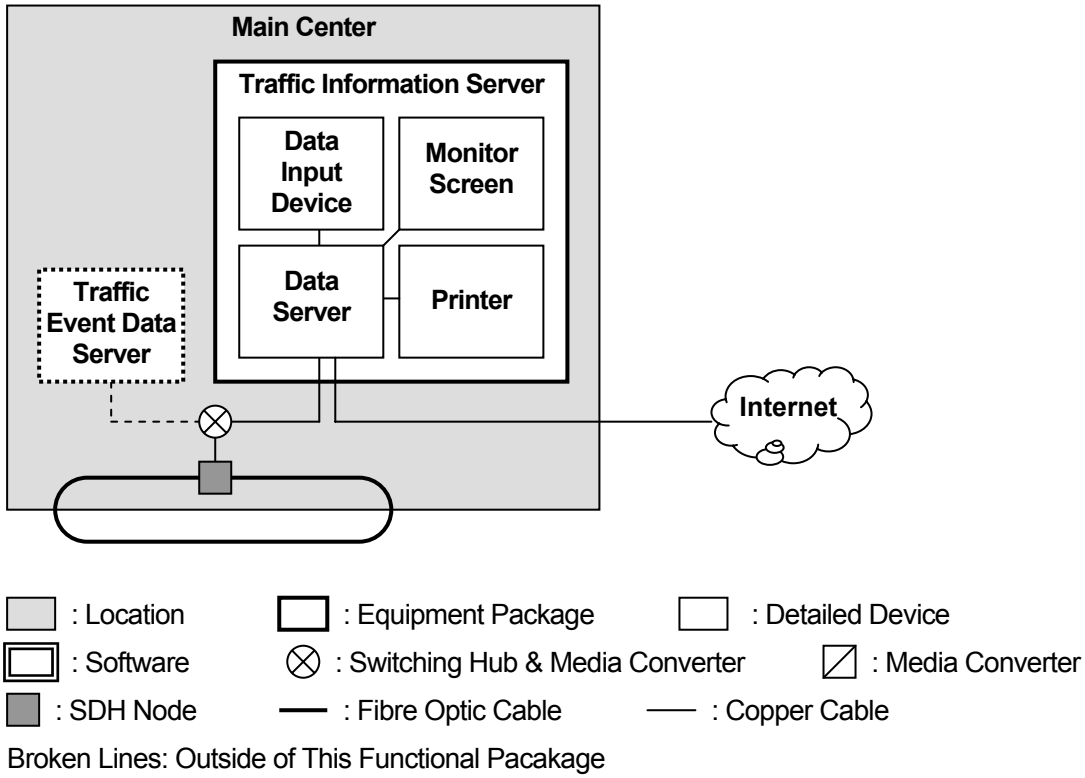
organizations with the information organized as traffic events on the expressways by using the Internet.

- **Center/Roadside Communication (Including Ducts):** This functional package allows the road operators to exchange data for ITS among the main centers, the road management offices and pieces of roadside equipment by using the backbone network among the centers, which comprises fibre optic cables installed in the shoulder along the expressways and communication nodes, and access network between communication nodes and roadside terminals.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **ITU:** The International Telecommunication Union is an agency of the United Nations which regulates information and communication technology issues. ITU coordinates the shared global use of the radio spectrum, promotes international cooperation in assigning satellite orbits, works to improve telecommunication infrastructure in the developing world and establishes worldwide standards.

5. Requirements

- System shall be capable of disseminating traffic and road condition information on expressways to internet users, including incident information, traffic regulation such as road closure, lane closure, entry closure, and current speeds on specific routes..
- System shall disseminate maintenance and construction information to internet users, including scheduled maintenance and construction work activities, and work zone activities.
- System shall be capable of disseminating service areas and parking areas information to internet users, including location, availability of services, and fees.
- System shall shall be capable of disseminating significant weather information to internet users.
- System shall provide capability for operators to control the type and update frequency of disseminated information.
- System shall be capable of generating required reports and printing out these reports.
- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions in the main center.

6. System Architecture



7. Traffic Information Server

7.1 Functions

- The system shall be capable of retrieving data from Traffic Event Data Server in Main Center in order to compiling traffic information for broadcast. The broadcast information contains traffic, road conditions, incidents, weather information and other related information.

- The system shall be capable of generating data to disseminate information for internet users to receive formatted traffic information from their homes, places of work, over multiple types of electronic media.

7.2 Structure

- The equipment components shall be capable of having adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against lightning.

- Chassis of equipment shall be capable of having a structure that cannot be opened easily, and the door on the chassis shall be equipped with a lock.

- Chassis of equipment shall be capable of absorbing temperature rising from inside equipment.

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

7.3 Performance (including Reliability)

- The server application shall be capable of retrieving from Traffic Event Data Server in the Main Center, compiling, and broadcasting incident information to internet users. The incident information for broadcast contains the following data set as described Table 7.1.

- The server application shall be capable of retrieving from Traffic Event Data Server in the Main Center the significant weather data, compiling and broadcasting significant weather information to internet users. The significant weather information for broadcast contains the following dataset as described in Table 7.2.

Table 7.1 Traffic Event Information Dissemination

Data Set	Data Element	Definition
Traffic Event Data Set	Traffic Event Data ID	ID Code of the traffic event data
	Causal Traffic Event Data ID	ID code of the causal traffic event data
	Date	Day/Month/Year when traffic event occurred
	Time	Hour/Minute/Second when a traffic event occurred
	Line ID	Line number of the road where a traffic event occurred
	Kilometer Post	Kilometer Post of the place where a traffic event occurred
	Road Link ID	Road link number of the place where a traffic event occurred
	Place Name ID	ID code of the place name where the traffic event occurred
	Traffic Event Category ID	Number of traffic event data category
	Traffic Event Class ID	Number of traffic ervent data class
	Main Center Check Status	Approval/Disapproval of the Main Center
	Office Check Status	Approval/Disapproval of Road Management Office
	Existing/Removed Status	Existence/removal of a traffic event

Table 7.2 Significant Weather Information Dissemination

Dataset	Data Element	Definition
Weather Data Set	Date*	Day/Month/Year of observation
	Time*	Hour/Minute/Second of observation
	Roadside Equipment ID*	ID code of roadside equipment used for weather monitoring
	Precipitation*	Hourly accumulated precipitation (converted by 10 min.data) measured by rain guage
	Wind Speed *	Wind speed (10 min.average) measured by wind sensor
	Visibility*	Visibility (10 min.average) measured by visibility sensor
	Temperature*	Temperature (10 min.average) measured by thermometer
	Heavy Rain Status **	Specifying significant weather in traffic event category and corresponding class of heavy rain in traffic event class
	High Wind Status**	Specifying significant weather in traffic event category and corresponding class of high wind speed in traffic event class
	Low Visibility Status**	Specifying significant weather in traffic event category and corresponding class of lowering of visibility in traffic event class
	High Temperature Status**	Specifying significant weather in traffic event category and corresponding high temperature warning in traffic event class

*Note: *: Data to be automatically generated, **: Data to be manually input*

- The server application shall be capable of disseminating traffic conditions and incident information to internet users with representation of text and traffic map.

- The server application shall be capable of disseminating maintenance and construction work activities, traffic regulation information to internet users, including anticipated closures and impact to the roadway, alternate routes, anticipated delays, speed limitations, closure times and durations.

- The server application shall provide capability for operators to input broadcast price data including parking price in rest area, toll amount for each vehicle class on expressway sections.

- The server application shall be capable of printing out the report of disseminated information.

- The Traffic Information Server should be setup as the server cluster (a group of independent servers working together as a single system) to provide high availability of services for clients. When a failure occurs on one computer in a cluster, resources are redirected and the workload is redistributed to another computer in the cluster. .

- The Traffic Information Server shall be capable of implementing data back-up on schedule.

7.4 Human Machine Interface

- The Traffic Information Server should be equipped with necessary Human Machine Interfaces such as monitor, keyboard and mouse.

7.5 Communication Interface

- The system shall be capable of transmitting the all data and signal in the Ethernet, communication protocol is 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

7.6 Installation

- The server application shall be installed on the operating system which is widely

available in many countries such as Windows, Linux etc.

- The equipment components of Traffic Information Server shall be installed in the Main Center

8. Ambient Conditions

- The equipment component shall be installed in the office which is protected from interferences of other electronic devices.

- The equipment component shall be capable of normally operating under the ambient conditions. The conditions shown in Table 8.1.

Table 8.1 Ambient Conditions

	Temperature	Relative Humidity
Main Center	Average 25 +/- 3 degrees C.	Average 20 – 80 %

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

9. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.

- System shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

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 it is detected, and the replacement of the parts shall be simple.

- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.

- The manufacturer of the equipment components shall submit the necessary documents necessary for the operation and maintenance such as manuals and check list, and necessary training shall be provided to the staffs to be work as O&M staffs of the related equipment components.

- The manufacturer of the equipment components shall make a contract on technical

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

11. Quality Control

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

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

12. Testing/Inspection

1) General

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

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

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

the consultant.

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

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

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

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

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

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission document

DRAFT GENERAL SPECIFICATIONS (12)

Lane Monitoring

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following Documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

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

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 tollbooths and toll offices 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 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. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or

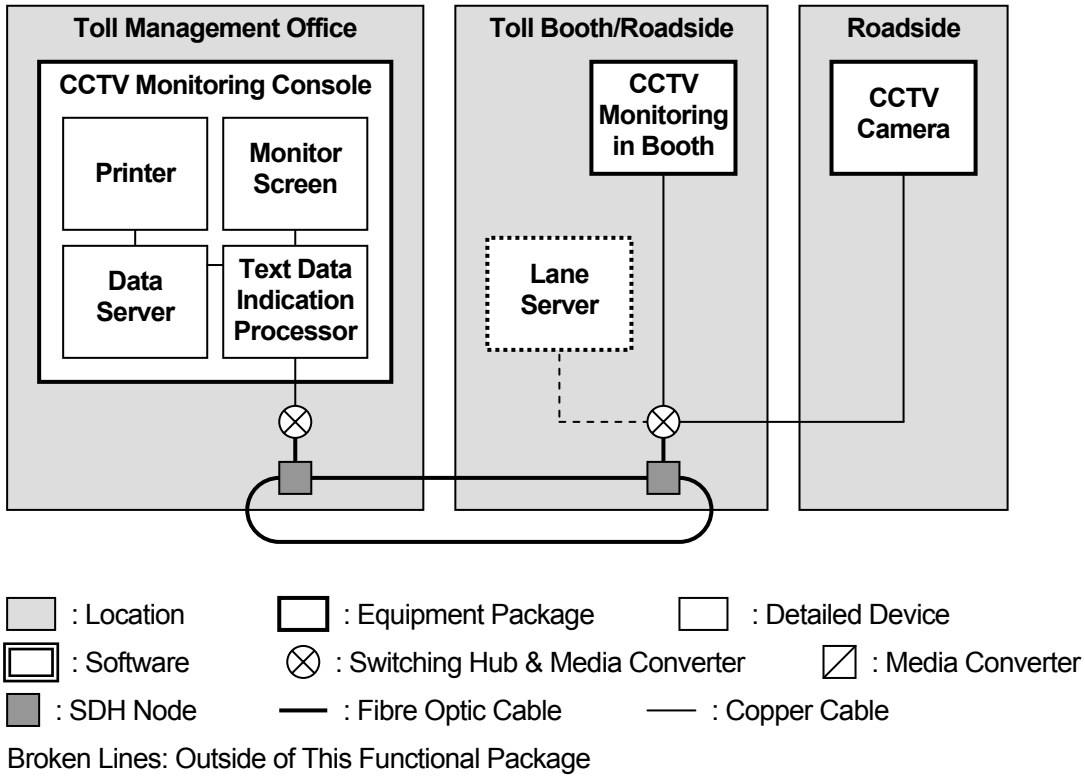
between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.

- **Traffic Information:** This functional package allows the road operators to provide other organizations with the information organized as traffic events on the expressways by using the Internet.
- **Lane Monitoring:** 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.
- **Toll Management:** 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 installed in the road management office.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **CCTV Camera:** Closed-Circuit Television Camera, which is used for producing images or recordings for surveillance purposes, and can be either video camera, or digital stills camera. Video cameras are either analogue or digital, so that they work on the basis of sending analogue or digital signals to a storage device such as a video tape recorder or computer. Video cameras are network cameras or IP cameras when embedded a video server having an IP address for video and audio streaming.
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.

5. Requirements

- System shall be capable of monitoring vehicles passing through a tollgate lane, in the toll booth and toll office, and identifying their classes such as trucks, buses and sedans.
- System shall be capable of monitoring situation of toll payment/receipt between a driver and a toll collector in the toll office.
- System shall be capable of storing the needed video image.
- System shall be capable of indicating and printing out the needed results.
- System shall be capable of installing roadside equipment adequately in the limited space around a tollgate lane.
- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

6. System Architecture



7. CCTV Camera

7.1 Functions

- The system shall be capable of monitoring vehicles on the toll lane and identifying types of the vehicles by their appearances.

- The system shall be capable of supervising money transferring transaction 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 the start-up.

- CCTV system shall be capable of correcting brightness of captured image automatically. (That is called as the function of iris.)

- CCTV system shall have auto-focus function to be controlled by using "CCTV Monitor Console".

7.2 Structure

- The countermeasures against dust and rainproof shall be taken on the CCTV camera installed in 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 the night-time conditions. .

- The camera shall be capable of complying with CS-mount standard.

- The equipment components shall not only have solid structure, shape, size, mass but also be as small and lightweight as possible.

- 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 outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall have adequate structure for 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 absorbing temperature rising from inside equipment and radiant solar heat.

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

7.3 Performance

- Field of view shall be 3,500mm in width and 4,750mm in height or over

- The object speed shall be 0~50km/h or over

- 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 be capable of presetting lens and pan head of the camera according to the control signal.

- The system shall have the interface of video image output to adjust angle of view of camera and the interface of control signal receiving to check camera operations for setting-up at installation site.

- The system shall have defroster function.

- CCTV camera shall be capable of shooting road traffic by at least Black/White image for continuously 24 hours a day for 365 days, except for maintenance and repair period

- The system shall have zooming function.

- The system shall have pan/title functions, those can be provided either by camera platform or all-in-one camera (PTZ camera). However, PTZ camera is advisable.

- The equipment component shall be supplied with Device Driver for controlling camera functions of panning/tilting and zooming. The camera shall be supported to interface of “CCTV Monitoring Console at Main Center”, if possible.

Table 7.1 Minimal Specification of CCTV Camera

	Typical Section
Camera Unit	
Image sensor	CCD Sensor Colour or B/W (CMOS Sensor is selectable)
Valid pixel of Sensor	> 380,000 pixel
Illumination	2-100,000 lx (Day mode), 0.5-100,000 lx (Night mode)
Resolution	> 480-360 pixel
Video Compression	MPEG-4 Part2 (ISO/IEC 14496-2) MPEG-4 Part10 (ISO/IEC 14496-10), AVS
Flame rate	> 15fps
Network Interface	100Base / 1GBase (RJ-45)
Range of surveillance	> 30.000m (without Zooming)
Lens Unit	
Focal length of lens	< 3.8mm
Zooming	> 20x optical (remote control)
Focusing	Automatic
Camera platform Unit	
Panning	+/- 170 degrees (remote control)
Tilting	100 degrees (remote control)
Housing Unit	
Ingress Protection	Equivalent IP66 *1
Relative Humidity	Average > 90 % (shall be equipped Defroster)
Acting temperature	-0 degrees C < < +50 degrees C

*1. IP66: No ingress of dust; complete protection against contact. Water projected in powerful jets against the enclosure from any direction shall have no harmful effects.

7.4 Communication Interface

- The system shall be capable of providing control signal to transmit the images in the Ethernet.

- The equipment components shall be capable of having following communication interfaces in order to ensure that equipment components to be controllable to CCTV, and accessible to CCTV video images from another equipment / console.
  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Transmission data format
  - Timing chart and other details of the standard interfaces

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

7.5 Installation

- The equipment components shall be installed at the toll island where they are capable of shooting to the front image of vehicle (included Licence Plate) .

- CCTV Camera installation height shall be 4.75m or over at the typical section, in accordance with the road clearance limits stipulated in TCVN4054:2005.

- Horizontal and vertical angle of CCTV camera shall be adjustable and shall be fixed appropriately.

- CCTV camera be capable of being vertically and horizontally adjusted during installation at roadside.

- Equipment components shall have adequate robustness against the wind of 60m/s speed or equivalent.

8. CCTV Monitoring in Toll Booth

8.1 Functions

- The system shall be capable of monitoring vehicle on the toll lane and of identifying vehicles by their appearance.

- The equipment components shall be capable of synchronizing its clock to the clock of "CCTV Monitoring Console" at the start-up.

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

8.2 Structure

- The equipment components shall be capable of having adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment shall be capable of absorbing temperature rising from inside equipment.

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

8.3 Performance

- The equipment of component shall be capable of displaying the images of CCTV camera.

- Recommended size of monitor screen is 14inchs (approx.) or over.

- Telephone device shall be equipped at toll booth for communication between Toll Collector and Toll Management Office.

- CCTV camera shall be capable of shooting road traffic by at least Black/White image for continuously 24 hours a day for 365 days, except for maintenance and repair period.

8.4 Communication Interface

- The system shall be capable of transmitting the all data and signal in the Ethernet, communication protocol is TCP/IP.

- The equipment components shall be capable of having following communication interfaces in order to ensure that equipment components to be controllable to CCTV, and accessible to CCTV video images from another equipment / console.
  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Transmission data format
  - Timing chart and other details of the standard interfaces

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

8.5 Installation

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

- The equipment components shall be installed in the Toll booth.

9. CCTV Monitoring Console

9.1 Functions

- The system shall be capable for monitoring vehicle on the toll lane and of identifying the vehicles by their appearance.

- The system shall be capable of supervising the money transferring transaction between toll collector and driver.

- The equipment components shall be capable of synchronizing its clock to the clock of "Traffic Supervising / Control Server" at the start-up.

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

9.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment shall be capable of absorbing temperature rising from inside equipment.

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

9.3 Performance

- The equipment of component shall be capable of displaying the images captured by CCTV camera.

- The system shall be capable of controlling the zoom, pan/tilt functions of all cameras.

- The system shall be capable of displaying the selected camera image on the monitor indicated by the operating staff.

- Recommended size of monitor screen is 20inchs (approx.) or over.

- The system shall be capable of allowing operating staff to monitor all displayed images .

- However, some issues are envisioned as follows:
  - The room space may not be enough to locate all necessary Monitor Screens.
  - The number of operators is not enough for monitoring all CCTV images displayed on Monitor Screens.

  Therefore, number of monitors should be controlled as follows:
  - Multi images shall be separately displayed on the same Monitor Screen.
  - Images of different cameras shall be displayed on the same Monitor Screen in defined rotating interval.

- The system shall be capable of capturing CCTV images as still picture.

- The system shall be capable of printing the captured image by using A4 type printer.

- The system shall be capable of printing the displayed images by using A4 type printer.

- Telephone device shall be equipped for communication between Toll Collector and Toll Management Office.

- The system shall be capable of accumulating captured CCTV images to the database at Data Server. Additionally, the system shall be capable of storing accumulated images for a certain time (approx. 30 days)

- The system shall be capable of displaying accumulated CCTV images on the monitor screen.

- CCTV camera shall be capable of shooting road traffic by at least Black/White image for continuously 24 hours a day for 365 days, except for maintenance and repair period

9.4 Human Machine Interface

- The equipment component shall have human-machine interface for the Traffic Information Operator to input necessary commands into the system.

- "CCTV monitor console" shall have user-friendly interface.

9.5 Communication Interface

- The system shall be capable of transmitting the all data and signals in the Ethernet, communication protocol is TCP/IP.

- The equipment components shall be capable of having following communication interfaces in order to ensure that equipment components to be controllable to 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.

9.6 Installation

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

- The equipment components shall be installed in the Toll Office.

10. Ambient Conditions

- The equipment component 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 ambient conditions. The conditions are shown in Table 10.1.

Table 10.1 Ambient Conditions

	Temperature	Relative Humidity
Main Center Toll Management Center Toll Office	Average 25 +/- 3 degrees C.	Average 20 – 80 %
Outside	-0 degrees C < < +50 degrees C	Average > 95 %

11. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.

- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

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

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

13. 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.

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

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

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

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

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

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The following steps shall be taken during project implementation.

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

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

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

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

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

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

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

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

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

4) Other Conditions

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

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

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

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

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DRAFT GENERAL SPECIFICATIONS (13)

Vehicle Identification

(Ver.1.0: Final Version of the Study Results)

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Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

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

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 tollbooths 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/IEC 14496-2: (MPEG4-Part 2)
- ISO/IEC 14496: (Coding of audio-visual objects)

- TCVN 4054:2005: Highway - Specifications for Design

4. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Vehicle Class:** A set of categories of vehicles for toll collection, traffic data or overloading regulation with definition of unique name/identifier to be applied to each category.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
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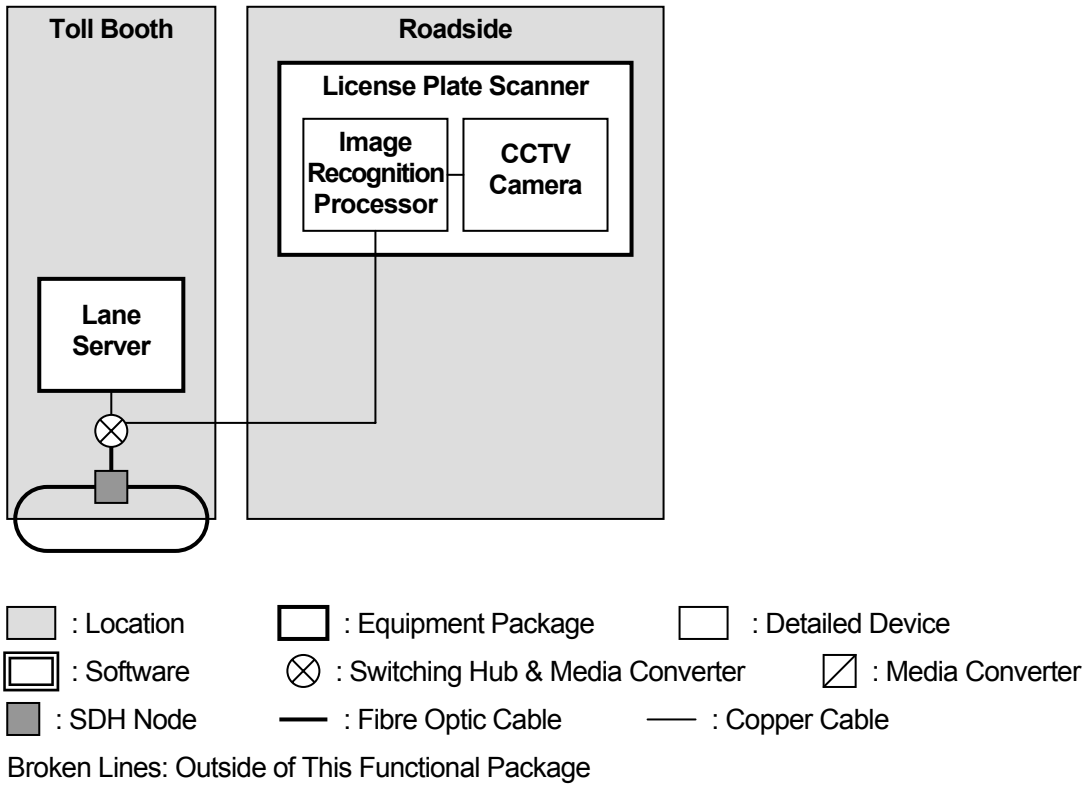
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Data Set:** A set of data elements included in a message with a strong relationship among them.
- **CCTV Monitoring:** This functional package allows the road operators to capture current situation of traffic accidents, broken-down vehicles, left obstacles, driving in the reverse direction, vandalism, natural disaster and traffic conditions on the expressways and to monitor the captured video image at the Main Centers and road management offices by using cameras installed at road sections where traffic can be stuck easily by incidents and at long tunnel sections.
- **Event Detection (by Image):** This functional package allows the road operators to automatically recognize occurrence of traffic accidents, broken-down vehicles and left obstacles on the expressways and to send notification to the Main Centers and road management offices by analyzing video images from cameras installed at bottleneck spots where traffic can be easily stuck and at long tunnel sections.
- **Vehicle Identification:** This functional package allows the road operators to identify individual vehicle by using a license plate scanner and other equipment installed in a separated lane such as a tollgate lane of the expressway.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **CCTV Camera:** Closed-Circuit Television Camera, which is used for producing images or recordings for surveillance purposes, and can be either video camera, or digital stills camera. Video cameras are either analogue or digital, so that they work on the basis of sending analogue or digital signals to a storage device such as a video tape recorder or computer. Video cameras are network cameras or IP cameras when embedded a video server having an IP address for video and audio streaming.
- **Image Recognition:** Software technology that uses computer algorithms to intelligently monitor real-time video for automatically recognizing license plate number of vehicle, vehicle speed, the occurrence of traffic accidents, broken-down vehicles, and left obstacles.
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer

multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.

5. Requirements

- System shall be capable of identifying the classes of vehicles passing through a tollgate lane, such as trucks, buses and sedans.
- System shall be capable of identifying the vehicles passing through a tollgate lane by their license number plate and storing the results.
- System shall be capable of installing roadside equipment adequately in the limited space around a tollgate lane.
- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

6. System Architecture



7. CCTV Camera

7.1 Functions

- The system shall be capable of monitoring vehicles on the expressway and identifying types of the vehicles by their appearances.

- The system shall be capable of taking a image of vehicle license number plate upon control signal.

- CCTV system shall be capable of correcting brightness of captured image automatically. (That is called as the function of iris.)

- 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 equipment components shall be capable of synchronizing its clock to the clock of “Traffic Supervising / Control Server” at the start-up.

7.2 Structure

- The countermeasures against dust and rainproof shall be taken on the CCTV camera installed in 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 the night-time conditions.

- The camera shall be capable of complying with CS–mount standard.

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall have adequate structure for performing maintenance

works from the 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 absorbing temperature rising from inside equipment and radiant solar heat.

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

7.3 Performance

- Field of view shall be 3,500mm in width and 4,750mm in height or over

- The object speed shall be 0~50km/h or over.

- 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 be capable of zooming, correcting brightness and focusing of the camera according to the control signal.

- The equipment components shall be capable of setting up 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 the interface of video image output to adjust angle of view of camera and the interface of control signal receiving to check camera operations for setting-up at installation site.

- CCTV camera shall be capable of shooting road traffic by at least Black/White image for continuously 24 hours a day for 365 days, except for maintenance and repair period.

- The system shall have zooming function.

- The equipment component shall be supplied with Device Driver for controlling camera functions of zooming. The camera shall be supported to interface of “CCTV Monitoring Console” as possible.

- The function of zooming of the CCTV cameras shall be controlled remotely and respectively using a keypad of the console in the Main Center. The camera control shall be conducted using IP corresponding to the camera identification number.

Table 7.1 Minimal Specification of CCTV Camera

	Typical Section
Camera Unit	
Image sensor	CCD Sensor Colour or B/W (CMOS Sensor is selectable)
Valid pixel of Sensor	> 380,000 pixel
Illumination	2-100,000 lx (Day mode), 0.5-100,000 lx (Night mode)
Resolution	> 480-360 pixel
Video Compression	MPEG-4 Part2 (ISO/IEC 14496-2) MPEG-4 Part10 (ISO/IEC 14496-10), AVS
Flame rate	> 15fps
Network Interface	100Base / 1GBase (RJ-45)
Range of surveillance	> 30.000m (without Zooming)
Lens Unit	
Focal length of lens	< 3.8mm
Focusing	Automatic
Housing Unit	
Ingress Protection	Equivalent IP66 *1
Relative Humidity	Average > 90 % (shall be equipped Defroster)
Acting temperature	-0 degrees C < +50 degrees C

*1. IP66: No ingress of dust; complete protection against contact. Water projected in powerful jets against the enclosure from any direction shall have no harmful effects.
*2. IP64: No ingress of dust; complete protection against contact. Water splashing against the enclosure from any direction shall have no harmful effect.
*3. Maximum range of surveillance: For a vehicle 1.5m wide to be recognized by the operator, the vehicle needs to be displayed clearly on the screen, size of the vehicle image on a 20-inch display more than 6mm

7.4 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is TCP/IP.

- The equipment components shall be capable of having following communication interfaces in order to ensure that equipment components to be controllable to CCTV, and accessible to CCTV video images from another equipment / console.
  - The name of implementation software
  - Bit allocation, which is needed for designing data transmission between transmission devices
  - Transmission data format
  - Timing chart and other details of the standard interfaces

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

7.5 Installation

- The equipment components shall be installed on the toll island where they are capable of shooting to the front image of vehicle (included Licence Plate).

- CCTV Camera installation height shall be 4.75m or more at the typical section, in accordance with the highway clearance limits stipulated in TCVN4054:2005.

- Horizontal and vertical angle of CCTV camera shall be adjustable, and shall be fixed appropriately.

- CCTV camera be capable of being vertically and horizontally adjusted during installation at site.

- Equipment components shall have adequate robustness against the wind of 60m/s speed or equivalent.

8. Image Recognition Processor

8.1 Functions

- The equipment components shall be capable for recognition vehicle license number plate on the toll lane and for identify the vehicle class automatically, Then the result of recognition is transmitted to “Toll Office Server”.

- The equipment components shall be capable of synchronizing its clock to the clock of “CCTV Monitoring Console” at the start-up.

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

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected with the measures against water, rust, dust, salt water in case the equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall have adequate structure for performing maintenance works from the 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 absorbing temperature rising from inside equipment and radiant solar heat.

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

8.3 Performance

- The equipment of components is capable of recognizing Vehicle license number plate automatically 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 relative information to “Toll Office Server”. Transmitting data are shown on Table 2.

Table 2 Data Frame for Number License Plate Recognition at “Toll Office Server”

Data Set	Principal Data Element	Update Cycle	Storage Period
Recognition Data set	Toll Office ID	Each vehicle passing	12 months
	Terminal ID	Each vehicle passing	12 months
	Date / time of Recognition	Each vehicle passing	12 months
	License Plate Number Data	Each vehicle passing	12 months
	Reliability of recognition	Each vehicle passing	12 months

- The equipment of components is capable of digitalising and outputting the reliability of recognition result which is represented the accuracy of the number plate recognition results.

- In case of the reliability of recognition results below the threshold level, the equipment of components is capable of indicating relevant text information (such as number plate information) as “F” instead of recognition results.

- The equipment of component is capable of transmitting the image of vehicle license number plate to “Toll Office Server”.

- All results of event detection shall be logged including not transmitted results

- The system shall have the interface of video image output to adjust angle of view of camera and the interface of control signal receiving to check camera operations for setting-up at installation site.

8.4 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is 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 which is widely available in many countries, such as Microsoft Windows or Linux.

9. Ambient Conditions

- The equipment component shall be installed in the offices, toll booth, outside and shall be protected with the measure against interferences of other electronic devices.

- The equipment component shall be capable of normally operating under the ambient conditions. The conditions are shown in Table 9.1.

Table 9.1 Ambient Conditions

	Temperature	Relative Humidity
Main Center Toll Management Center Toll Office	Average 25 +/- 3 degrees C.	Average 20 – 80 %
Outside	-0 degrees C < < +50 degrees C	Average < 95 %

10. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.

- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

11. Maintainability

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

- The equipment components shall be capable of identifying the faulty parts easily in case equipment fault is detected, and the replacement of the parts shall be simple.

- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.

- The manufacturer of the equipment components shall submit the necessary documents necessary for the operation and maintenance such as manuals and check list, and necessary training shall be provided to the staffs to be work as O&M staffs of the related equipment components.

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

12. 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.

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

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

(2) After the factory test procedure is approved, the factory test shall be executed by the

manufacturer, and the result shall be submitted to the road management authority and the consultant.

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

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

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

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

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

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (14)

Lane Control

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following Documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

This functional package allows the road operators to eliminate the vehicle passages without adequate toll collection by using a computer, vehicle detectors, signs and a barrier installed in a separated tollgate lane of the expressway.

2. Scope

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 tollbooths 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
- TCCS 01:2008/VRA: TRẠM THU PHÍ ĐƯỜNG BỘ THU PHÍ MỘT DỪNG SỬ DỤNG ẤN CHỈ MÃ VẠCH
- TVCN 6384:1998: Mã số mã vạch vật phẩm - Mã UPC-A - Yêu cầu kĩ thuật
- TVCN 6513:1999: Mã số mã vạch vật phẩm - Mã vạch ITF - Yêu cầu kĩ thuật
- TVCN 6755:2008 ISO/IEC 15417:2007: Mã số mã vạch vật phẩm - Mã vạch EAN-UCC 128 – Quy định kĩ thuật

4. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Vehicle Class:** A set of categories of vehicles for toll collection, traffic data or overloading regulation with definition of unique name/identifier to be applied to each category.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined

as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.

- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Message:** A set of data to be exchanged between subsystems for transferring information.
- **Data Set:** A set of data elements included in a message with a strong relationship among them.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **CCTV Monitoring:** This functional package allows the road operators to capture current situation of traffic accidents, broken-down vehicles, left obstacles, driving in the reverse direction, vandalism, natural disaster and traffic conditions on the expressways and to monitor the captured video image at the Main Centers and road management offices by using cameras installed at road sections where traffic can be stuck easily by incidents and at long tunnel sections.
- **Lane Control:** This functional package allows the road operators to eliminate the vehicle passages without adequate toll collection by using a computer, vehicle detectors, signs and a barrier installed in a separated tollgate lane of the expressway.
- **Toll Management:** 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 installed in the road management office.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **Vehicle Detector:** A sensor either embedded in the pavement or mounted above the expressway to provide vehicle volume, speed, counts, headway, queue lengths, and vehicle classifications.
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer

multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.

5. Requirements

- System shall be capable of generating/processing the data appropriate for collecting toll based on the data sent from IC-card and OBU, the results of vehicle class identification and the regulated toll rate system.

- System shall be capable of securing an average service-time by non-stop less than 4.5 sec/vehicle and by one-stop less than 9.0 sec/vehicle.

- System shall be capable of processing the data for collecting toll putting the vehicle class judged by toll collector on a higher priority.
- System shall be capable of notifying a driver, in case of prepaid balance shortage for required toll amount, the necessity to recharge prepaid balance before next time of system usage including the amount of shortage.

- System shall be capable of notifying the data for collecting toll and the results of processing the data.

- System shall be capable of inhibiting the vehicles without normal completion of toll collection.

- System shall be capable of rejecting in-coming of the vehicles beyond the legal limits of dimensions.

- System shall be capable of generating/storing identification data of the vehicles without normal completion of toll collection.

- System shall be capable of indicating and printing out the needed results.

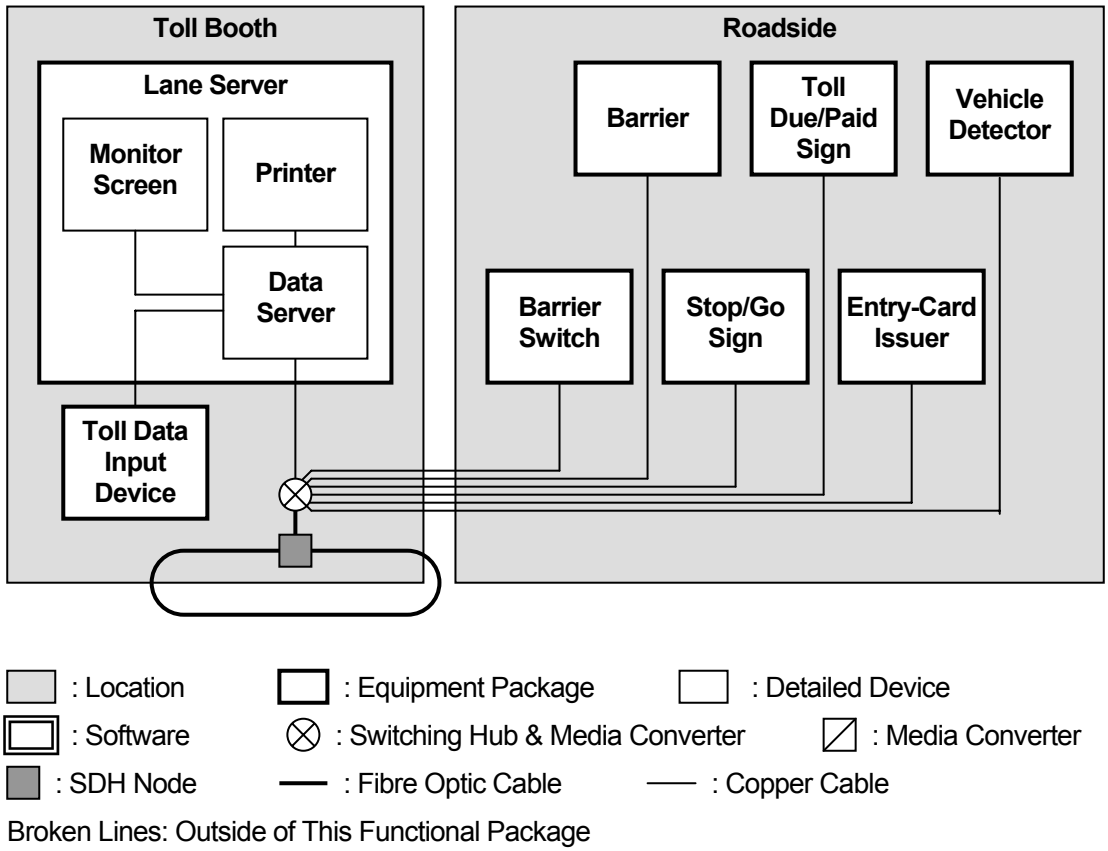
- System shall be capable of installing roadside equipment adequately in the limited space around a tollgate lane.

- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

- Capable for toll collector to collect the proper toll manually in case the registered vehicle type of OBU is obviously judged as error compared with the visually checked one.

- System should be assured to be less affected by the disorder outside and the being overheard but still execute toll collection quickly and accurately.

6. System Architecture



7. Lane Server

7.1 Functions

- The equipment components shall be capable of calculating 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”.

- The equipment components shall be capable of receiving the data as shown in Table 7.1, Table 7.5 and Table 7.9 from “Roadside Controller”, “IC-Card R/W” and “Toll Data Input Device” at the Entry Tollgate.

- The equipment components shall be capable of transmitting the data as shown in Table 7.2 and Table 7.6 to “Roadside Controller”, “IC-Card R/W” and “Toll Data Input Device” at the Entry Tollgate.

- The equipment components shall be capable of receiving the data as shown in Table 7.3 and Table 7.7 from “Roadside Controller”, “IC-Card R/W” and “Toll Data Input Device” at the Exit Tollgate.

- The equipment components shall be capable of transmitting the data as shown in Table 7.4 and Table 7.8 to “Roadside Controller”, “IC-Card R/W” and “Toll Data Input Device” at the Entry Tollgate.

(1) For Touch & Go

[At Entry Tollgate] The equipment components shall be capable of receiving the data as shown in Table 7.1 from “IC-Card R/W” .

[At Entry Tollgate] The equipment components shall be capable of transmitting the data as shown in Table 7.2 to “IC-Card R/W”.

[At Exit Tollgate] The equipment components shall be capable of receiving the data as shown in Table 7.3 from “IC-Card R/W”.

[At Exit Tollgate] The equipment components shall be capable of transmitting the data as shown in Table 7.4 to “IC-Card R/W”.

Table 7.1 Touch & Go : Data Set and Principal Data Elements
(Receive from IC-Card R/W at the Entry)

Data Set	Principal Data Element	Update Cycle
IC-Card contract data set	IC-Card ID	IC-Card issue
	Issuer ID	IC-Card issue
	Issue terminal ID	IC-Card issue
	Date of issue	IC-Card issue
	Date of expiry	IC-Card issue
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge
Transaction Data set	Termination sign *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Table 7.2 Touch & Go: Data Set and Principal Data Elements
(Transmit to IC-Card R/W at the Entry)

Data Set	Principal Data Element	Update Cycle
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge
IC-Card Passage History Data set	Tollgate ID	Each vehicle passing
	Lane Server ID	Each vehicle passing
	Date / Time	Each vehicle passing
	Toll amount	Each vehicle passing
Transaction Data set	Termination sign *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Table 7.3 Touch & Go: Data Set and Principal Data Elements
(Receive from IC-Card R/W at the Exit)

Data Set	Principal Data Element	Update Cycle
IC-Card contract data set	IC-Card ID	IC-Card issue
	Issuer ID	IC-Card issue
	Issue terminal ID	IC-Card issue
	Date of issue	IC-Card issue
	Date of expiry	IC-Card issue
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge / Each vehicle passing
IC-Card Passage History Data set	Tollgate ID	Each vehicle passing
	Lane Server ID	Each vehicle passing
	Date / Time	Each vehicle passing
	Toll amount	Each vehicle passing
Transaction Data set	Termination sign *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Table 7.4 Touch & Go: Data Set and Principal Data Elements
(Transmit to IC-Card R/W at the Exit)

Data Set	Principal Data Element	Update Cycle
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge / Each vehicle passing
IC-Card Passage History Data set	Tollgate ID	Each vehicle passing
	Lane Server ID	Each vehicle passing
	Date / Time	Each vehicle passing
	Toll amount	Each vehicle passing
Transaction Data set	Termination sign *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Note,*: It is remark that the IC-Card is completed the transaction on Entry or Exit.
**: It is remark for the IC-Card is voided or not.
***: It is for against illegal duplication of IC-Card.

(2) For Non-stop ETC

[At Entry Tollgate] The equipment components shall be capable of receiving the data as shown in Table 7.5 from “Roadside Controller”.

[At Entry Tollgate] The equipment components shall be capable of transmitting the data as shown in Table 7.6 to “Roadside Controller”.

[At Exit Tollgate] The equipment components shall be capable of receiving the data as shown in Table 7.7 from “Roadside Controller”.

[At Exit Tollgate] The equipment components shall be capable of transmitting the data as shown in Table 7.8 to “Roadside Controller”.

Table 7.5 Non-stop ETC: Data Set and Principal Data Elements
(Receive from Roadside Controller at the Entry)

Data Set	Principal Data Element	Update Cycle
IC-Card contract data set	IC-Card ID	IC-Card issue
	Issuer ID	IC-Card issue
	Issue terminal ID	IC-Card issue
	Date of issue	IC-Card issue
	Date of expiry	IC-Card issue
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge
OBU Registration Data set	OBU ID	OBU registration
	Date of issue	OBU registration
	License number	OBU registration
	Vehicle class	OBU registration
Transaction Data set	Termination sign *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Table 7.6 Non-stop ETC: Data Set and Principal Data Elements
(Transmit to Roadside Controller at the Entry)

Data Set	Principal Data Element	Update Cycle
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge
OBU Passage Data set	Tollgate ID	Each vehicle passing
	Lane server ID	Each vehicle passing
	Date / Time	Each vehicle passing
	Toll amount	Each vehicle passing
Transaction Data set	Termination sign *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Table 7.7 Non-stop ETC: Data Set and Principal Data Elements
(Receive from Roadside Controller at the Exit)

Data Set	Principal Data Element	Update Cycle
IC-Card contract data set	IC-Card ID	IC-Card issue
	Issuer ID	IC-Card issue
	Issue terminal ID	IC-Card issue
	Date of issue	IC-Card issue
	Date of expiry	IC-Card issue
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge
OBU Registration Data set	OBU ID	OBU registration
	Date of issue	OBU registration
	License number	OBU registration
	Vehicle class	OBU registration
OBU Passage Data set	Tollgate ID	Each vehicle passing
	Lane server ID	Each vehicle passing
	Date / Time	Each vehicle passing
	Toll amount	Each vehicle passing
Transaction Data set	Termination sign *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Table 7.8 Non-stop ETC: Data Set and Principal Data Elements
(Transmit to Roadside Controller at the Exit)

Data Set	Principal Data Element	Update Cycle
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge / Each vehicle passing
OBU Passage Data set	Tollgate ID	Each vehicle passing
	Lane server ID	Each vehicle passing
	Date / Time	Each vehicle passing
	Toll amount	Each vehicle passing
Transaction Data set	Termination sign *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Note,*: It is remark that the IC-Card is completed the transaction on Entry or Exit.
**: It is remark for the IC-Card is voided or not.
***: It is for against illegal duplication of IC-Card.

(3) For Manual collection

[At Entry Tollgate] The equipment components shall be capable of transmitting the data as shown in Table 7.9 to "Entry-Card Issuer".

[At Exit Tollgate] The equipment components shall be capable of receiving the data as shown in Table 7.9 from "Toll Data Input Device".

Table 7.9 Manual: Data Set and Principal Data Elements
(Received from Toll Data Input Device at the Entry)

Data Set	Principal Data Element	Update Cycle
Bar-code Data set	Road Operator ID	Each vehicle passing
	Tollgate ID	Each vehicle passing
	Ticket Type	Each vehicle passing
	Vehicle Class	Each vehicle passing
	Date of issue	Each vehicle passing
	Date of expiry	Each vehicle passing
	Deposit terminal ID	Each vehicle passing
	Serial number	Each vehicle passing

- 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.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected against water, rust, dust, salt water in case that equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall be capable of 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 absorbing temperature rising from inside equipment and radiant solar heat.

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

7.3 Performance

- The equipment components shall be capable of transmitting all transaction data such as the transaction information that received from “Roadside Controller” or the control information of Sign and Barrier to “Toll Management Server”.

- The equipment components shall be capable of reading "Date of expiry" in the "IC-Card” and checking whether the card has expired or not. In case the IC card has expired, the following operations shall be performed:

- Displaying the text “Stop” on “Stop/Go” sign board
- Closing “Barrier”

- The equipment components shall be capable of checking whether the most recent transmission has been performed at Entry Tollgate or Exit Tollgate based on the “Termination sign” information read from the “IC-Card”.

- The equipment components shall be capable of recording the number of transaction and (corresponding to the passage times through tollgates) to the “Transaction counter” in “IC-Card” in order to check whether the "IC-card" is being counterfeited or not or information writing on the “IC-Card” is fully completed or not.

- The equipment components shall be capable of storing the "Invalidation-list" that received from "Toll Office Server". The Invalidation list is shown in Table 7.10.

Table 7.10 Data Set and Principal Data Elements in Invalidation List

Data Set	Principal Data Element	Update
Invalidation List	Invalidated IC-Card ID	One time in a week (Except in emergency arise)

- In case of "Invalidated IC-Card ID" is indicated on the "Invalidation-list", a flag as "Permanently voided code" is written on it to express meaning that it is a permanently un-usable 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 arbitrarily.

(1) For Manual / Touch & Go

- The equipment components shall be capable of transmitting the "Vehicle class" information that received from "Toll Data Input Device" to "Classification Sign". The "Vehicle class" is chosen and inputted by "Toll Collector".

- In case of the IC-Card ID is not found on the "Invalidation list": The equipment components shall be capable of calculating the toll amount based on the information sent from "Toll Data Input Device", "IC-Card R/W" and "Entry-Card", such as IC-Card ID, Tollgate ID, Vehicle Class, and performing the following operations:

  [At Entry Tollgate]
  - Displaying the Vehicle Class on "Classification Sign".
  - Writing the Tollgate ID, Lane Server ID, Date / Time and Completion / end sign on IC-Card by "IC-Card R/W"
  - Displaying the text "Go" on "Stop/Go" sign board
  - Opening Barrier

  [At Exit Tollgate]

- Displaying the Vehicle Class on “Classification Sign”.
- Displaying the status of toll collection on “Toll Due/Paid” sign board
- Writing the “Prepaid balance”, “Tollgate ID”, “Lane Server ID”, “Date / Time”, “Toll amount”, “Completion / end sign” and “Transaction counter” on IC-Card by “IC-Card R/W”
- Displaying the text “Go” on “Stop/Go” sign board
- Opening Barrier

- The equipment components shall be capable of writing 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 or the Exit Tollgate.

- **At Entry Tollgate]**
  The equipment components shall be capable of writing the entry tollgate information (as Table 1 and Table 5), without considering whether the “Termination sign” is written or not.

- **[At Exit Tollgate]**
  The equipment components shall be capable of performing the following operations in case of the “Termination sign” is not written.
  - displaying the text “Stop” on “Stop/Go” sign board
  - Closing barrier

- The system shall be capable of performing the following operations if IC-Card ID is found on the “Invalidation list”:
  - writing “Permanently voided code” on the IC-Card
  - displaying the text “Stop” on “Stop/Go” sign board
  - closing barrier

- In case of the “IC-Card” balance is insufficient, the system shall be capable of receiving the “Warning Command” that sent from ”IC-Card R/W” and performing the following operations:
  - Informing the Toll Collector about shortage
  - Display “Stop” to “Stop / Go Sign”.
  - Closing Barrier

(2) For Non-stop ETC

- The equipment components shall be capable of transmitting the “Vehicle class” information that received from “Roadside Controller” to “Classification Sign”.

- In case of 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 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 or 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 of the “Termination sign” is not written.
  - displaying the text “Stop” on “Stop/Go” sign board
  - Closing barrier

- The system shall be capable of performing the following operations in case of the IC-Card ID is found on the “Invalidation list”.
  - Writing “Permanently voided code” on the IC-Card
  - Displaying the text “Stop” on “Stop/Go” sign board
  - Closing barrier

- In case of the “IC-Card” balance is insufficient, the system shall be capable of receiving the “Warning Command” that sent from ”Roadside Controller” and performing the following operations:
  - Informing the Toll Collector about shortage.
  - Displaying the text “Stop” on “Stop/Go” signboard.
  - Closing Barrier.

7.4 Human Machine Interface

- The equipment components shall be capable of notifying the normal/abnormal transmission and insufficient balance to the users.

7.5 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is 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 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 which is widely available in many countries, such as Microsoft Windows or Linux.

- The equipment components shall be installed on the toll island.

8. Toll Data Input Device

8.1 Functions

- Toll data input device shall be equipped for toll collector to input the vehicle class information that 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 that displayed on the “CCTV Monitoring in Booth”.

- In case of the vehicle is equipped with OBU, the system shall be capable of displaying the vehicle class information that received from “Roadside Controller”.

- In case of the IC-Card balance is insufficient, the system shall be capable of displaying and notifying the insufficient balance on screen.

- In case of 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.

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected against typhoon, fire, earthquake, sandstorm and lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment components shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.

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

8.3 Performance

(1)For 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)For 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.

8.5 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is 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 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 which is widely available in many countries, such as Microsoft Windows or Linux.

- The equipment components shall be installed in the toll booth.

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.

9.2 Structure

- Solid barriers shall be designed to avoid damages from vehicle conflicts.

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected against water, rust, dust, salt water in case that equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall be capable of 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 absorbing temperature rising from inside equipment and radiant solar heat.

- The equipment components shall be protected with the 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 the control from Lane Server and Barrier Switch.

- The prior order of controlling Barrier is ranked the first from Barrier Switch and second from Lane Server.

9.4 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is 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 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 equipment components shall be installed at the terminal edge of Toll Island.

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 of there is the difference between the vehicle class is determined by Toll Collector and the vehicle class recorded in OBU.)

10.2 Structure

- The equipment component is operated hardly and urgently when the vehicle running without toll payment, therefore “Barrier Switch” shall have adequate robustness for hard operation.

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected against typhoon, fire, earthquake, sandstorm and lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment components shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.

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

10.3 Performance

- The prior order of controlling Barrier is ranked the first from Barrier Switch and second from Lane Server.

- 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 the control 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 operation of alarm and flashing lights when the “Barrier Switch” is operated.

10.4 Human Machine Interface

- The equipment component shall be capable of operating hardly and urgently when the

vehicle burst through the toll lane without toll payment, therefore “Barrier Switch” shall be capable of having the appropriate shape avoiding hurt to toll collector hands.

10.5 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is 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 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.

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.

11.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected against water, rust, dust, salt water in case that equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment components shall have adequate structure for easily performing maintenance works from the its 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 absorbing temperature rising from inside equipment and radiant solar heat.

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

11.3 Performance

- The equipment components shall be capable of receiving the toll amount information 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 on the “Toll Due/Paid Sign” while the vehicle is passing through toll lane.

11.5 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is 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 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.

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.

12.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected against water, rust, dust, salt water in case that equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment components shall have adequate structure for easily performing maintenance works from the its 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 absorbing temperature rising from inside equipment and radiant solar heat

- The equipment components shall be protected with the 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 prior order of controlling Barrier is ranked the 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 lane.

12.5 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is 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 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.

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 inputted from “Toll Data Input Device” by toll collector.

13.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected against typhoon, fire, earthquake, sandstorm and lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment components shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.

- The equipment components shall be protected with the 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 took off by toll collector

13.5 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is 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 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.

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 inputted 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.

14.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected against water, rust, dust, salt water in case that equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment components shall have adequate structure for easily performing maintenance works from the its 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 absorbing temperature rising from inside equipment and radiant solar heat.

- The equipment components shall be protected with the 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 that 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 the all data and signals in the Ethernet, communication protocol is 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 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.

15. Vehicle Detector

15.1 Functions

- Measuring the number of vehicles passing through the toll lane.

15.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected against water, rust, dust, salt water in case that equipment components are installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment components shall have adequate structure for easily performing maintenance works from the its 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 absorbing temperature rising from inside equipment and radiant solar heat.

- The equipment components shall be protected with the 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 the all data and signals in the Ethernet, communication protocol is 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 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.

16. Ambient Conditions

- The equipment component 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 ambient conditions. The conditions shown in Table 16.1.

Table 16.1 Ambient Conditions

	Temperature	Relative Humidity
Main Center Toll Management Center Toll Office	Average 25 +/- 3 degrees C.	Average 20 – 80 %
Outside	-0 degrees C < < +50 degrees C	Average > 95 %

17. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.

- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

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 road management authority, and the manufacturer shall guarantee this spare parts supply period.

- The manufacturer of the equipment components shall submit the necessary documents necessary for the operation and maintenance such as manuals and check list, and necessary training shall be provided to the staffs to be work as O&M staffs of the related equipment components.

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

19. 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.

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

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

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

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

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

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

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

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (15)

Road-to-Vehicle Communication

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following Documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

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Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

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

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, for actualizing this functional package. This Specifications deal with the equipment components and software in-vehicle as well.

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- 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 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. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Vehicle Class:** A set of categories of vehicles for toll collection, traffic data or overloading regulation with definition of unique name/identifier to be applied to each category.
- **Interchange:** A junction connecting an expressway network and an arterial road network. That comprises grade separation and ramps to permit traffic on the expressway to pass through the junction without directly crossing other traffic on the arterial road.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces

necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).

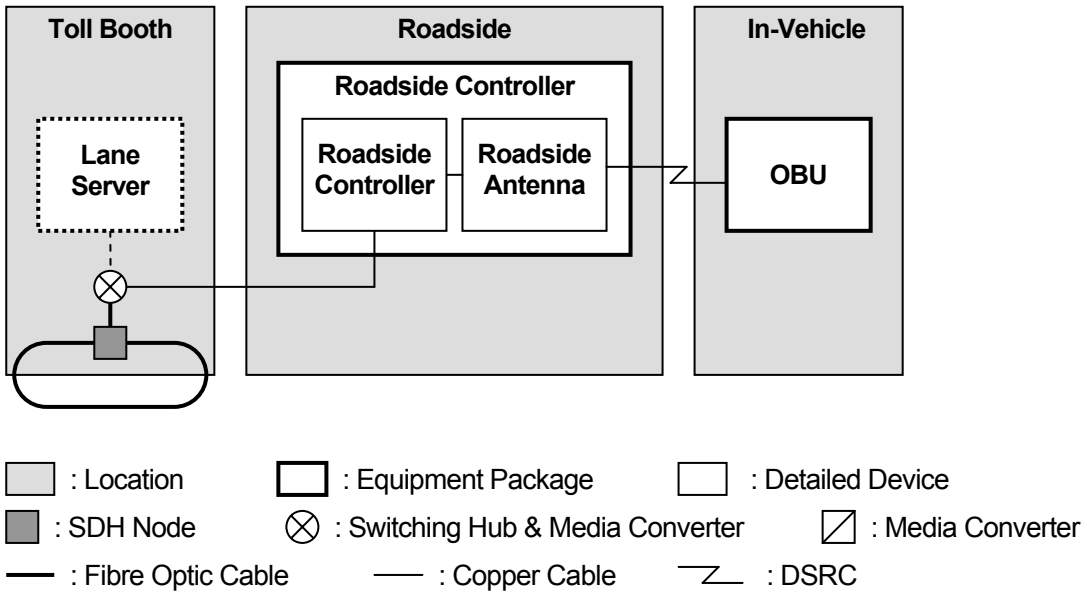
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Data Set:** A set of data elements included in a message with a strong relationship among them.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **Road-to-Vehicle Communication:** 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.
- **Toll Management:** 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 installed in the road management office.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **ITU:** The International Telecommunication Union is an agency of the United Nations which regulates information and communication technology issues. ITU coordinates the shared global use of the radio spectrum, promotes international cooperation in assigning satellite orbits, works to improve telecommunication infrastructure in the developing world and establishes worldwide standards.
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs).

Lower data rates can also be transferred via an electrical interface.

5. Requirements

- System shall be capable of notifying the data for collecting toll and the results of processing the data.
- System shall be capable of securing an average service-time by non-stop less than 4.5 sec/vehicle.
- System shall be capable of securing undisturbed conditions by disconcertion/tapping from outside and restricting an error ratio less than 1%.
- System shall be capable of installing roadside equipment adequately in the limited space around a tollgate lane.
- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

6. System Architecture



7. OBU (On-Board Unit)

7.1 Functions

- 2-piece OBU and 1-piece OBU are considered.

- 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 Table 7.1.

Table 1 Data Set and Principal Data Elements in "OBU"

Data Set	Principal Data Element	Update Cycle
OBU Registration Data set	OBU ID	OBU registration
	Date of issue	OBU registration
	License number	OBU registration
	Vehicle class	OBU registration
OBU Passage Data set	Tollgate ID	Each vehicle passing
	Lane Server ID	Each vehicle passing
	Date / Time	Each vehicle passing
	Toll amount	Each vehicle passing

- The system shall be capable of communicating between with OBU and Roadside Antenna by radio communication.

- The equipment of component shall be capable of reading the information of the IC card which is installed in the OBU and transmitting to Roadside Controller through the Roadside Antenna.

Table 7.2 Data Set and Principal Data Elements of "Roadside controller"

Data Set	Principal Data Element	Update Cycle
IC-Card contract data set	IC-Card ID	IC-Card issue
	Issuer ID	IC-Card issue
	Issue terminal ID	IC-Card issue
	Date of issue	IC-Card issue
	Date of expiry	IC-Card issue
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge
Transaction Data set	Termination flag *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Note,*: It is remark that the IC-Card is completed the transaction on Entry or Exit.
**: It is remark for the IC-Card is voided or not.
***: It is for against illegal duplication of IC-Card.

- The equipment of component shall be capable of reading the Prepaid Balance in the IC-Card Recharge Data set of the IC card which is installed in OBU, OBU has the function of reminding the driver in case the balance falls below a certain amount of money.

- The system shall be capable of complying with International Standard.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily.

- The equipment of component 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 of component shall have small size in order not to hinder vision of the operation after the installation.

- The equipment of component shall be capable of being firmly installed to avoid being demounted easily.

- The chassis of equipment components shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.

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

7.3 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 on the basis of 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 of components shall be capable of writing promptly the OBU Passage Data set (refer to Table 7.3), which is saved in the OBU, to the IC-Card Passage History Data set (refer to Table 7.4) of the IC Card when the IC card is removed from OBU.,

Table 7.3 Data Set and Principal Data Elements of OBU Passage Data set

Data Set	Principal Data Element	Update Cycle
OBU Passage Data set	Tollgate ID	Each vehicle passing
	Lane Server ID	Each vehicle passing
	Date / Time	Each vehicle passing
	Toll amount	Each vehicle passing

Table 7.4 Data Set and Principal Data Elements of IC-Card Passage History Data set

Data Set	Principal Data Element	Update Cycle
IC-Card Passage History Data set	Tollgate ID	Each vehicle passing
	Lane Server ID	Each vehicle passing
	Date / Time	Each vehicle passing
	Toll amount	Each vehicle passing

- The equipment component shall be capable of normally operating under the ambient conditions. The conditions shown in Table 7.5.

Table 7.5 Ambient Conditions

	Temperature	Relative Humidity
In Cars	-25 degrees C < < +85 degrees C	Average < 95 %

7.4 Human Machine Interface

- The equipment of component shall be capable of reading the Prepaid Balance in the IC-Card Recharge Data set of the IC card which is installed in OBU, OBU has the function of reminding the driver in case the balance falls below a certain amount of money.

7.5 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is 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 capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

7.6 Installation

- The equipment of component 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.

8. Roadside Antenna

8.1 Functions

- The equipment of component shall be capable of transmitting and receiving 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 8.1.

Table 8.1 Data Set and Principal Data Elements of Roadside Antenna

Data Set	Principal Data Element	Update Cycle
IC-Card contract data set	IC-Card ID	IC-Card issue
	Issuer ID	IC-Card issue
	Issue terminal ID	IC-Card issue
	Date of issue	IC-Card issue
	Date of expiry	IC-Card issue
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge
OBU Registration Data set	OBU ID	OBU registration
	Date of issue	OBU registration
	License number	OBU registration
	Vehicle class	OBU registration
OBU Passage Data set	Tollgate ID	Each vehicle passing
	Lane Server ID	Each vehicle passing
	Date / Time	Each vehicle passing
Transaction Data set	Termination flag *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

- The equipment components shall be capable of communicating with OBU by radio communication.

- The equipment components shall be capable of synchronizing its clock to the clock of “Traffic Supervising / Control Server” at the start-up.

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

8.2 Structure

- The equipment components shall be capable of having adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment component is installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.

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

8.3 Performance

- The communication zone of Roadside antenna shall range within 1.0m to ground level 4.0m to vehicle driving direction, 3.5m to lane direction.

- The equipment of component shall be capable of communicating with the OBU that is running at the speed over 50km/h.

- The equipment of component shall be capable of transmitting specified carrier wave and the data to “OBU”.

- The equipment of component shall be capable of performing data transmission control to “OBU” upon the command of “Roadside Controller”.

- The system shall be capable of complying with International Standard.

- In relation to an error probability of transmission between Roadside Antenna and OBU, bit error rate (Bit Error Rate - BER) must be less than $10^{-6.}$

- The equipment components is capable of preparing the countermeasure for promptly and credibly transaction, such as “multiple calling”.

- The equipment component is capable of determining the place of occurred transmission error, when it occurred due to factors of the system.

- The system is capable of transmitting the Entry Interchange Information in “OBU” for toll calculation and collect toll at the Exit tollgate, using the Entry Interchange Information .

8.4 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is 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 Roadside Antenna shall be installed higher than 4.75m.

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

- The equipment components shall be installed near the toll booth to perform reading/writing the data from/into OBU upon the instructions of upper device.

9. Roadside Controller

9.1 Functions

- The equipment of component 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 9.1.

Table 9.1 Data Set and Principal Data Elements of Roadside Antenna

Data Set	Principal Data Element	Update Cycle
IC-Card contract data set	IC-Card ID	IC-Card issue
	Issuer ID	IC-Card issue
	Issue terminal ID	IC-Card issue
	Date of issue	IC-Card issue
	Date of expiry	IC-Card issue
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
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Transaction Data set	Termination flag *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

- The equipment of component 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 of component shall be capable of transmitting data relevant to toll collection by controlling command from Lane Server.

- The equipment components shall be capable of synchronizing its clock to the clock of "Traffic Supervising / Control Server" at the start-up.

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

9.2 Structure

- The equipment components shall be capable of allowing the user easily to perform operations with “IC-Card” when passing over the equipment component that located near the toll booth.

- The equipment components shall be capable of having adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment component is installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall be capable of having adequate structure for 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 absorbing temperature rising from inside equipment and radiant solar heat.

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

9.3 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 be capable of complying with International Standard.

- In relation to an error probability of transmission between Roadside Antenna and OBU, bit error rate (Bit Error Rate - BER) must be less than $10^{-6.}$

- The equipment components is capable of preparing the countermeasure for promptly and credibly transaction, such as “multiple calling”.

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9.5 Installation

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

- The equipment components shall be installed near the toll booth to perform reading/writing the data from/into Roadside Antenna upon the instructions of upper device.

10. Ambient Conditions

- The equipment component 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 normally operating under the ambient conditions. The conditions shown in Table 10.1.

Table 10.1 Ambient Conditions

	Temperature	Relative Humidity
Main Center Toll Management Center Toll Office	Average 25 +/- 3 degrees C.	Average 20 – 80 %
Outside	-0 degrees C < < +50 degrees C	Average < 95 %

11. Power supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.

- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

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 road management authority, and the manufacturer shall guarantee this spare parts supply period.

- The manufacturer of the equipment components shall submit the necessary documents necessary for the operation and maintenance such as manuals and check list, and necessary training shall be provided to the staffs to be work as O&M staffs of the related equipment components.

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

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- 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.

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

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

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

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(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (16)

IC-Card Recording

(Ver.1.0: Final Version of the Study Results)

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- ISO/IEC 18092: Near Field Communication – Interface and protocol

4. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Interchange:** A junction connecting an expressway network and an arterial road network. That comprises grade separation and ramps to permit traffic on the expressway to pass through the junction without directly crossing other traffic on the arterial road.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or

between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.

- **Data Set:** A set of data elements included in a message with a strong relationship among them.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **IC-Card Recording:** 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.
- **Toll Management:** 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 installed in the road management office.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **IC-card:** Integrated Circuit card, which is any pocket-sized card with embedded integrated circuits. There are two broad categories of IC-Cards. Memory cards contain only non-volatile memory storage components. Microprocessor cards contain volatile memory and microprocessor components. The card is used for identification or financial transaction.
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.

5. Requirements

- System shall be capable of notifying the data for collecting toll and the results of processing the data.

- System shall be capable of securing an average service-time by one-stop collection less than 9.0 sec/vehicle.
  (*Average service-time is the duration when one car halts behind another which is stopping for departure toll collection until the car departs when the collection finishes)

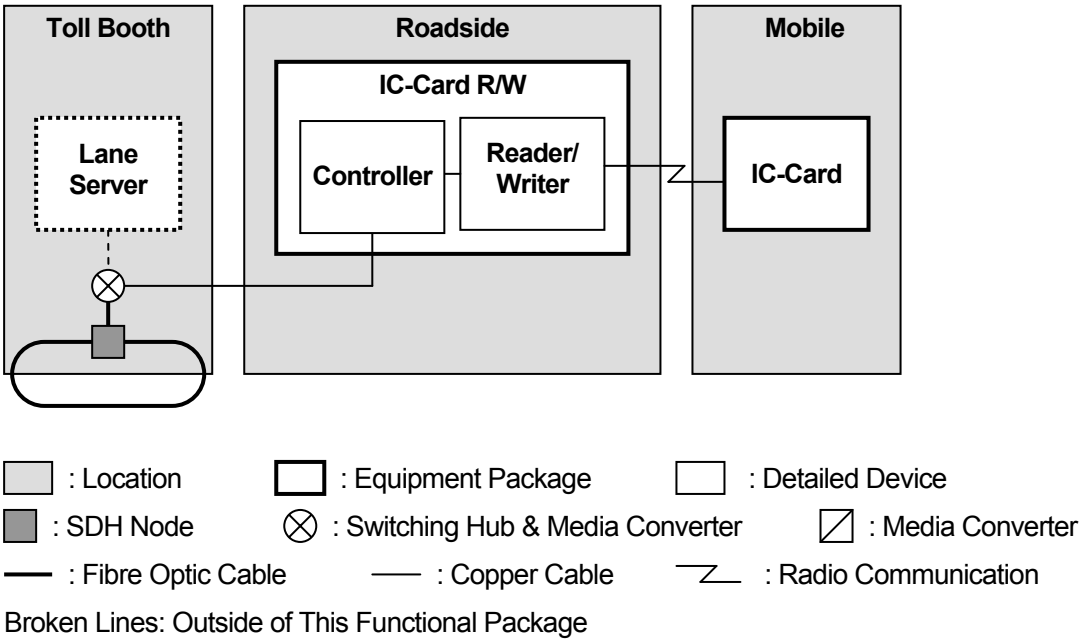
- The system should make the payment promptly and credibly, avoid being disturbed by outside factors or eavesdropping.

- System shall be capable of prepaying and storing prepaid balance in the IC-card.

- System shall be capable of installing roadside equipment adequately in the limited space around a tollgate lane.

- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at installation site on roadside.

6. System Architecture



7. IC-Card

7.1 Functions

- The equipment components 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 Table 7.1.

Table 7.1 Data Set and Principal Data Elements in "IC-Card"

Data Set	Principal Data Element	Update Cycle
IC-card contract data set	IC-card ID	IC-Card issue
	Issuer ID	IC-Card issue
	Issue terminal ID	IC-Card issue
	Date of issue	IC-Card issue
	Date of expiry	IC-Card issue
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge
IC-Card Passage History Data set	Tollgate ID	Each vehicle passing
	Lane Server ID	Each vehicle passing
	Date / Time	Each vehicle passing
	Toll amount	Each vehicle passing
Transaction Data set	Determination flag*	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Note,*: It is remark that the IC-card is completed the transaction on Entry or Exit.
**: It is remark for the IC-card is voided or not.
***: It is for against illegal duplication of IC-card.

- "IC-Card" shall be capable of storing up to 10 records of toll collection history. The content of data set is listed in the table below.

Table 7.2 Data Set and Principal Data Elements for Toll history data

Data Set	Principal Data Element
Toll collection history data	Date/time (1)
	Entry Inter Change ID (1)
	Exit Inter Change ID (1)
	Toll amount (1)
	Date/time (2)
	Entry Interchange ID (2)
	Exit Interchange ID (2)
	Toll amount (2)
	Date/time (3)
	Entry Inter Change ID (3)
	Exit Inter Change ID (3)
	Toll amount (3)
	:
	Date/time (10)
	Entry Inter Change ID (10)
	Exit Inter Change ID (10)
	Toll amount (10)

- The equipment components shall be capable of communicating with IC cards by radio communication.

- Data transmission shall be carried out by the method based on ISO / IEC 14443: contactless Integrated Circuit Cards, or the Standard ISO / IEC 18092: Near Field Communication - Interface and protocol.

7.2 Structure

- Shape of the "IC-Card" shall base on ISO / IEC 14443 standards: contactless Integrated Circuit Cards.

7.3 Performance (including Reliability)

- The communication between "IC-Card" with "IC-Card Reader/Writer" shall be contactless.

- In case "Invalidated IC Card ID" is indicated on "Invalidation-list", the "IC-Card" shall be written a flag in "Permanently voided code" to be a permanently non-usable card when the card is 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.

7.4 Human Machine Interface

- To allow the IC-card be identified by visual observation, 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)

7.5 Communication Interface

- The system shall have communication interface from "IC-Card" to "IC-Card Reader/Writer" as shown in Table 2.

Table 7.3 Communication interface from "IC-Card" to "IC-Card Reader/Writer"

Item	Specifications
Encoding method	NRZ-L or Manchester or Modified Miller
Initial transmission rate	> 105kbit/s

- Necessary information or specification of equipment components shall be 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. IC-Card R/W (Reader/Writer)

8.1 Functions

- "IC-Card Reader/Writer" shall be capable of reading the data stored in "IC-Card" and transmitting the data to "Lane Server". The stored data are shown in Table 8.1 and Table 8.2.

Table 8.1 Touch & Go : Data Set and Principal Data Elements
(Receive from IC-Card at the Entry)

Data Set	Principal Data Element	Update Cycle
IC-card contract data set	IC-card ID	IC-Card issue
	Issuer ID	IC-Card issue
	Issue terminal ID	IC-Card issue
	Date of issue	IC-Card issue
	Date of expiry	IC-Card issue
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge
Transaction Data set	Determination flag *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Table 8.2 Touch & Go: Data Set and Principal Data Elements
(Receive from IC-Card at the Exit)

Data Set	Principal Data Element	Update Cycle
IC-card contract data set	IC-card ID	IC-Card issue
	Issuer ID	IC-Card issue
	Issue terminal ID	IC-Card issue
	Date of issue	IC-Card issue
	Date of expiry	IC-Card issue
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge / Each vehicle passing
IC-Card Passage History Data set	Tollgate ID	Each vehicle passing
	Lane Server ID	Each vehicle passing
	Date / Time	Each vehicle passing
Transaction Data set	Determination flag *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Note,*: It is remark that the IC-card is completed the transaction on Entry or Exit.
**: It is remark for the IC-card is voided or not.
***: It is for against illegal duplication of IC-card.

- "IC-Card Reader/Writer" shall be capable of writing the data controlled by "Lane Server". The data are shown in Table 8.3 and Table 8.4.

Table 8.3 Touch & Go: Data Set and Principal Data Elements
(Transmit to IC-Card at the Entry)

Data Set	Principal Data Element	Update Cycle
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge
IC-Card Passage History Data set	Tollgate ID	Each vehicle passing
	Lane Server ID	Each vehicle passing
	Date / Time	Each vehicle passing
Transaction Data set	Determination flag *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Table 8.4 Touch & Go: Data Set and Principal Data Elements
(Transmit to IC-Card at the Exit)

Data Set	Principal Data Element	Update Cycle
IC-Card Recharge Data set	Deposit terminal ID	Each recharge
	Date of deposit	Each recharge
	Amount of deposit	Each recharge
	Prepaid balance	Each recharge / Each vehicle passing
IC-Card Passage History Data set	Tollgate ID	Each vehicle passing
	Lane Server ID	Each vehicle passing
	Date / Time	Each vehicle passing
	Toll amount	Each vehicle passing
Transaction Data set	Determination flag *	Each vehicle passing
	Permanently voided code **	Each vehicle passing
	Transaction counter ***	Each vehicle passing

Note,*: It is remark that the IC-card is completed the transaction on Entry or Exit.
**: It is remark for the IC-card is voided or not.
***: It is for against illegal duplication of IC-card.

- "IC-Card Reader / Writer" shall be capable of reading the toll collection history data stored in "IC-Card" . The stored data are shown in Table 8.

- The equipment components shall be capable of writing the toll collection history data up to 10 records. In case of the history data is above 10 records, oldest data is deleted then newest data is written.

- The equipment components shall be capable of writing Date/time (1), Entry Tollgate ID (1), Exit Tollgate ID (1) and Toll amount (1) as newest history data, Date/time (10), Entry Tollgate ID (10), Exit Tollgate ID (10), Toll amount (10) as oldest history data on the Table 8.5.

Table 8.5 Data Set and Principal Data Elements for Toll history data

Data Set	Principal Data Element
Toll collection history Data set	Date/time (1)
	Entry Tollgate ID (1)
	Exit Tollgate ID (1)
	Toll amount (1)
	Date/time (2)
	Entry Tollgate ID (2)
	Exit Tollgate ID (2)
	Toll amount (2)
	Date/time (3)
	Entry Tollgate ID (3)
	Exit Tollgate ID (3)
	Toll amount (3)
	:
	Date/time (10)
	Entry Tollgate ID (10)
	Exit Tollgate ID (10)
	Toll amount (10)

- The equipment components shall be capable of communicating with IC cards by radio communication.

- The equipment components shall be capable of synchronizing its clock to the clock of "Traffic Supervising / Control Server" at the start-up.

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

8.2 Structure

- The equipment components shall be capable of allowing the user easily to perform operations with "IC-Card" when passing over the equipment component that located near the toll booth.

- The equipment components shall be capable of having adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against typhoon, fire, earthquake, sandstorm and lightning.

- The equipment components shall be protected with the measures against water, rust, dust, salt water in case that equipment component is installed outdoor.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment components shall be capable of having adequate structure for performing maintenance works from the it's sides and/or back, but not from lane direction, in order to minimize the influence to traffic activities.

- The chassis of equipment components shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.

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

8.3 Performance

- The communication between "IC-Card" with "IC-Card Reader/Writer" shall be contactless.

- The IC-Card Reader/Writer shall be capable of transmitting specified carrier wave, power and data to "IC-card".

- The IC-Card Reader/Writer shall be capable of capturing the change of magnetic flux from "IC-Card" for receiving data.

- The IC-Card Reader/Writer shall be capable of performing data transmission control to "IC-Card" upon the command of "Lane Server".

- Data transmission shall be carried out by the method based on ISO / IEC 14443: contactless Integrated Circuit Cards, or the Standard ISO / IEC 18092: Near Field Communication - Interface and protocol.

- In relation to an error probability of transmission between IC-Card R/W and IC-Card, bit error rate (Bit Error Rate - BER) must be less than $10^{-6.}$

- The equipment components is capable of preparing the countermeasure for promptly and credibly transaction, such as "multiple calling".

- The equipment component is capable of determining the place of occurred transmission error, when it occurred due to factors of the system.

- The system is 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" credibly..

- The system is capable of confirmation "Prepaid balance" and "Termination flag" in "IC-Card". In case "Prepaid balance" is insufficient, notify to driver and send "Warning

command" to "Lane Server".

- The system shall be capable of writing Remark on "Termination flag" in "IC-card". This remark helps to determine the transmission (writing Entry Interchange information, toll collection transaction, recharge transaction) was done correctly or not at the Entry Interchange or whether Exit Interchange.

- The IC-Card Reader / Writer shall be capable of checking the most recent transmission is done at Entry Interchange or Exit Interchange by using ""Termination flag" of "IC-card".

- The system shall be capable of writing the number of transmission (the same as number of passing tollgates) in "Transaction counter" of "IC-Card" for the diagnosis whether the "IC-card" is being counterfeited or writing information is completed or not in the "IC-card".

- The system shall be capable of performing following activities if the IC-Card ID is found on the "Invalidation list":
  - Writing "Permanently voided code" in the IC-Card
  - Displaying the text "Stop" on "Stop/Go" sign board
  - Closing "Barrier"

- The "IC-Card Reader / Writer" shall be capable of reading "Permanently voided code" in the "IC-card" and checking the card is permanently unusable or not. In case of the card is permanently unusable, following operations shall be done;
  - Displaying the text "Stop" on "Stop/Go" sign board
  - Closing "Barrier"

- The equipment components shall be capable of demodulating carrier wave 's change of magnetic flux from "IC-Card" for receiving the data. This transaction shall be compliance with standards of ISO / IEC 14443 or ISO/IEC 18092. The major specifications shall be as follows:

- The carrier frequency shall be 13.56MHz.

- The operating range from the antenna center to directions must be at least ±30mm on X-axis, ±30mm on Y-axis, 50mm on Z-axis. However, in consideration of the method of holding up the card system, the operating range should be as large as possible.

8.4 Human Machine Interface

- The equipment components shall be capable of notifying normal/abnormal and insufficient prepaid balance on "IC Card" to the users.

8.5 Communication Interface

- The system shall have communication interface from “IC-Card Reader/Writer” to “IC-Card” as shown in Table 8.6.

Table 8.6 Communication Interface between “IC-Card Reader/Writer” and “IC-Card”

Item	Specifications
Main carrier wave	13.56MH z
Modulation method	ASK
Encoding method	NRZ-L or Manchester or Modified Miller
Operation range	Refer to Figure 1

- The transmission devices shall have 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.

8.6 Installation

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

- The equipment components shall be installed near the toll booth to perform reading/writing the data from/into Contact-less IC card upon the instructions of upper device.

9. Ambient Conditions

- The equipment component 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 normally operating under the ambient conditions. The conditions are shown in Table 9.1.

Table 9.1 Ambient Conditions

	Temperature	Relative Humidity
Main Center Toll Management Center Toll Office	Average 25 +/- 3 degrees C.	Average 20 – 80 %
Outside	-0 degrees C < < +50 degrees C	Average < 95 %

10. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.

- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

11. Maintainability

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

- The equipment components shall be capable of identifying the faulty parts easily in case it is detected, and the replacement of the parts shall be simple.

- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.

- The manufacturer of the equipment components shall submit the necessary documents necessary for the operation and maintenance such as manuals and check list, and necessary training shall be provided to the staffs to be work as O&M staffs of the related equipment components.

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

12. 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.

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

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

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

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

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

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

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

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (17)

Toll Management

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following Documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

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

This Draft General Specifications deal with the equipment components and software to be installed in toll offices and the toll management centres of the expressway network for actualizing 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. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Vehicle Class:** A set of categories of vehicles for toll collection, traffic data or overloading regulation with definition of unique name/identifier to be applied to each category.
- **Main Center:** The Center in charge of traffic monitoring, traffic control and traffic information dissemination, and is to be cooperated with road management offices.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
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- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.

- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Message:** A set of data to be exchanged between subsystems for transferring information.
- **Data Set:** A set of data elements included in a message with a strong relationship among them.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **Toll Management:** 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 installed in the road management office.
- **OBU Management:** This functional package allows to register on-board units by using equipment installed in OBU issue offices, and allows to generate/manage the registration list and the invalidation list of on-board units by using computers and software installed in the OBU registration center.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **OBU:** On-Board Unit. The in-vehicle device component of an ETC system. A receiver or transceiver permitting the Operator's Roadside Unit (RSU) to communicate with, identify, and conduct an electronic toll transaction; also called a 'transponder' or 'tag.'
- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.

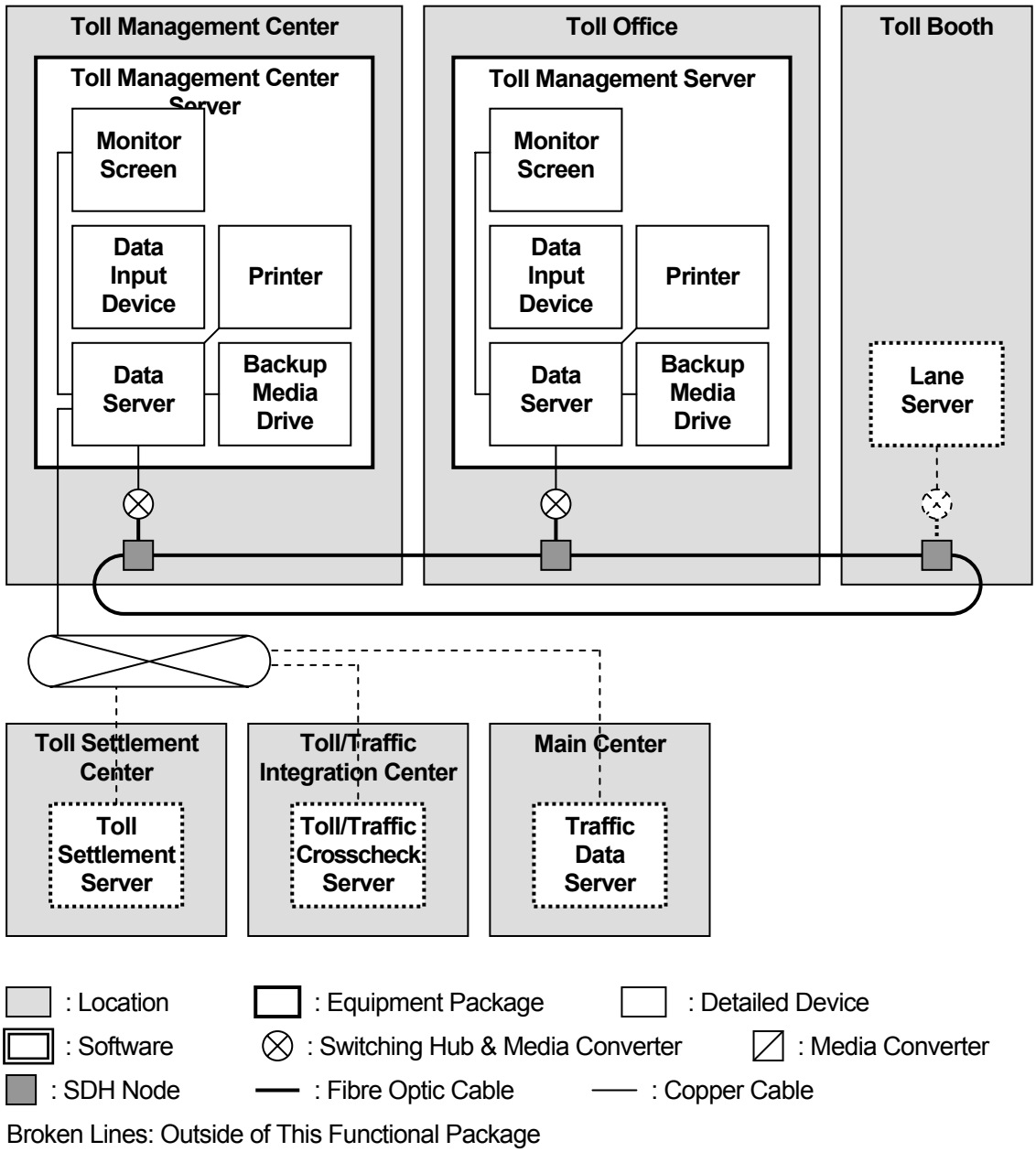
5. Requirements

- 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 a redundant system and sufficient durability/reliability of equipment components.

6. System Architecture



7. Toll Management Center Server

7.1 Functions

- The equipment components shall be capable of receiving, compiling and managing the Transaction data, Toll collection data relating to toll collection from Toll Management Server from each Tollgate.

- The equipment components shall be capable of receiving the related information of enforcements (such as Crackdown of fraudulence), from each subordinate equipment.

- The equipment components shall be capable of detecting the vehicle which is suspected of fraudulence from Enforcement Data Set

- The equipment components shall be capable of composing the Invalidation list based on the information which is transmitted from each Toll Settlement Server such as Lost IC-Card and Suspended IC-Card; and the information which is transmitted from each OBU Management Server such as Lost OBU and Suspended OBU.

- The system shall be capable of storing all Transaction data, Toll collection data related to toll collection. The required retention period of the data is shown on Table3.

- 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 the measures against lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment components shall be capable of absorbing temperature rising from inside equipment and radiant solar heat.

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

7.3 Performance

- The system shall be capable of calculating toll amount by the items mentioned in the Table 1 for the road section under management scope of each toll office based on Daily Transaction data and Toll Collection Data which are sent from “Toll Management Server”

located at each “Toll Office”

- The system shall be capable of calculating toll amount and traffic volume classifying by each vehicle class and by each IC card ID as mentioned in Table 7.1, upon vehicle classification policy of the Ministry of Finance.

- The system shall be capable of compiling the statistic data and making report such as daily report, weekly report, monthly report, and yearly report.

- The system shall be capable of transmitting the statistic data including transaction data and toll collection data to “Toll Clearance Server” at “Toll Settlement Center”

- The system shall be capable of transmitting the statistic data including transaction data and toll collection data to “Toll/Traffic Crosscheck Server” at “Toll/Traffic Integration Center”

- The system shall be capable of transmitting the Transaction data, Toll collection data to “Toll Clearance Server” at “Toll Settlement Center”

- The system shall be capable of transmitting the Transaction data, Toll collection data to “Toll/Traffic Crosscheck Server” at “Toll/Traffic Integration Center”

Table 7.1 Data Set and Principal Data Elements for Compile of Toll collection

Data Set	Principal Data Element	Update Cycle
Toll Collection Data	Toll Company ID	Every day
	Date	Every day
	Sum of toll amount	Every day
	Toll amount of Class 1	Every day
	Toll amount of Class 2	Every day
	Toll amount of Class 3	Every day
	Toll amount of Class 4	Every day
	Toll amount of Class 5	Every day
Traffic Volume data	Traffic volume of all Cars (through the tollgate)	Every day
	Traffic volume of Class 1	Every day
	Traffic volume of Class 2	Every day
	Traffic volume of Class 3	Every day
	Traffic volume of Class 4	Every day
	Traffic volume of Class 5	Every day
IC Card Collection data	Toll Company ID	Every day
	Date	Every day
	IC Card ID (1)	Every day
	Toll amount of IC card ID (1)	Every day
	IC Card ID (2)	Every day
	Toll amount of IC card ID (2)	Every day
	IC Card ID (3)	Every day
	Toll amount of IC card ID (3)	Every day
	IC Card ID (4)	Every day
	Toll amount of IC card ID (4)	Every day
	:	:
	IC Card ID (N)	Every day
	Toll amount of IC card ID (N)	Every day

* The vehicle class is according to Vehicle Classification Policy

- The system shall be capable of transmitting the Traffic volume data (through the tollgate) to “Toll/Traffic Crosscheck Server” which is located at “Toll/Traffic Integration Center”.

- The system shall be capable of allowing to receive the “Invalidation-list” of the IDs of stolen and/or suspended OBUs or IC cards from Toll Clearance Server which is located at Toll Settlement Centre. The data Set and data elements in Invalidation List is shown in Table 7.2.

- The system shall be capable of sending the “Invalidation-list” to “Toll Management Server”

Table 7.2 Data Set and Principal Data Elements in Invalidation List

Data Set	Principal Data Element	Update
Invalidation list	Invalidated IC Card ID	One time in a week (Except in emergency arise)

- The system shall be capable of storing all Transaction data, Toll collection data related to toll collection. Necessary storage period is shown in Table 7.3.

Table 7.3 Data Set and Principal Data Elements for Toll Management

Data Set	Principal Data Element	Update Cycle	Storage Period
Transaction Data set	Lane server ID	Each vehicle passing	1 year
	Date/time	Each vehicle passing	1 year
	OBU ID	Each vehicle passing	1 year
	IC Card ID	Each vehicle passing	1 year
	Vehicle class	Each vehicle passing	1 year
	License number (by OBU)	Each vehicle passing	1 year
	Termination sign	Each vehicle passing	1 year
Toll collection Data set	Toll Office ID	Every 5 min	1 year
	Tollgate ID	Every 5 min	1 year
	Date/time	Every 5 min	1 year
	Sum of toll amount	Every 5 min	1 year
	License number (by scan)	Every 5 min	1 year
	Enforcement status	Every 5 min	1 year
	Transaction data Sets	Every 5 min	1 year

- The equipment component shall be capable of retrieving and displaying the transaction records from which are stored Transaction Data, Toll Collection data by using retrieve condition elements which are inputted by using “Data Input Device”.

- Stored Transaction data and Toll collection data shall be backed up.

- The system shall be capable of receiving “OBU Registration data” from “OBU Registration Terminal”.

- At that time, the system shall be capable of updating according to received “OBU Registration data” and backing-up “OBU Registration data” before updating.

- The following backup shall be done for system backup.

  [Continuous data protection backup]
  (1) Backup is to restore HDD of Data Server when it is being crushed
  Using the manipulation such as RAID to usually store data alike in the same section of HDD

  [Full + Incremental backup]
  (2) Backup is to restore data in the case of data lost in Data Server
  Make a copy of all data in Data Server then stored in another HDD monthly and daily back up the changes as compared to the backup the day before

[Full System backup]
(3) Copy and storage all software and data of Toll Management Center Server.

- The system shall be capable of extracting necessary information from Transaction Data, Toll collection data is stored in Data Server based on search criteria which is input from Data Input Device, then displaying on Monitor Screen. The minimum search criteria are as follow:
  - IC-Card ID
  - OBU ID
  - ID of Toll gate
  - ID of Toll lane
  - Name of toll gate
  - Vehicle information (such as Vehicle class, Number Plate and etc)
  - Date and time

- The system shall be capable of displaying the retrieve results on the monitor screen.

- The system shall be capable of printing information which is displayed on Monitor Screen.

- Recommended size of monitor screen shall be 20inchs (approx.) or over.

- All consoles shall have user-friendly interface.

- The system shall be capable of printing retrieved results by A4/A3 type printer.

- The equipment component shall be capable of saving the compiled data in CSV form. It shall be capable of being accessed and modified using commercially application software (such as Microsoft Excel).

- The Banking Data Input Console shall be installed separately in Main Center for the transmission of the billing data to the Toll Settlement Server.

- Toll Management Server and Banking Data Input Device shall be equipped with Removable Device of the same specification for offline inputting the billing data into the Banking Data Input console in order to keep banking security.

- System should have Uninterruptible Power Supply (UPS) to prepare for power failure. Back-up power must be capable for more than 2 hours of power supply

7.4 Human Machine Interface

- The equipment components shall have the human machine interface for “Operator” to input searching conditions for retrieve the “Transaction data” and “Toll collection data” and for adding and adjusting “Invalidation List”.

7.5 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is TCP/IP.

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

7.6 Installation

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

8. Toll Management Server

8.1 Functions

- The equipment components shall be capable of receiving, compiling and managing the Transaction data, Toll collection data relating to toll collection from Lane Server from each Tollgate.

- The equipment components shall be capable of receiving the related information of enforcements (such as Crackdown of fraudulence), from each subordinate equipment.

- The equipment components shall be capable of detecting the vehicle which is suspected of fraudulence from Enforcement Data Set

- The equipment components shall be capable of receiving the invalidation list from Toll Management Center Server, and then the invalidation list shall be transmitted to Lane Server.

- The system shall be capable of storing all Transaction data, Toll collection data related to toll collection. Required storage capacity is shown on Table 5.

- The system shall be capable of synchronizing its clock to the clock of “Toll Management Center Server” at the start-up period. By the clock synchronization, the system can be capable of picking out required information from the database in the “Data Server”

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

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment components shall be capable of absorbing temperature rising from inside equipment.

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

8.3 Performance

- System shall be capable of storing all Transaction data, Toll collection data related to toll collection. Necessary storage period is shown in Table 5.

- The system shall be capable of transmitting the Transaction data, Toll collection data to “Toll Management Center Server” which is located at “Toll Management Center”.

- Data Elements of each Transaction Data, Toll collection data are shown in Table 8.1.

Table 8.1 Data Set and Principal Data Elements for Toll Management

Data Set	Principal Data Element	Update Cycle	Storage Period
Transaction Data set	Lane server ID	Each vehicle passing	1 year
	Date/time	Each vehicle passing	1 year
	OBU ID	Each vehicle passing	1 year
	IC Card ID	Each vehicle passing	1 year
	Vehicle class	Each vehicle passing	1 year
	License number (by OBU)	Each vehicle passing	1 year
	Termination sign	Each vehicle passing	1 year
Toll collection Data set	Toll Office ID	Every 5 min	1 year
	Tollgate ID	Every 5 min	1 year
	Date/time	Every 5 min	1 year
	Sum of toll amount	Every 5 min	1 year
	License number (by scan)	Every 5 min	1 year
	Enforcement status	Every 5 min	1 year
	Transaction data Sets	Every 5 min	1 year

- The system shall be capable of receiving “Invalidation-list” which is recorded by ID such as stolen OBU or IC Card, from Toll Settlement Server which is located at Settlement Centre.

- The system shall be capable of recording "Invalidation-list" on the Data Server, and sending it to the "Lane Server".

Table 8.2 Data Set and Principal Data Elements in Invalidation List

Data Set	Principal Data Element	Update
Invalidation list	Invalidated IC Card ID	One time in a week (Except in emergency arise)

- The system shall be capable of retrieving and displaying the transaction records from which are stored on the database (such as Transaction Data, Toll Collection data) by using retrieve condition elements which are inputted using “Data Input Device”.

- Stored Transaction data and Toll collection data shall be backed up.

- The system shall be capable of receiving “OBU Registration data” from “Toll Management Center Server”

- At that time, the system shall be capable of updating according to received “OBU Registration data” and backing-up “OBU Registration data” before updating..

- The system shall be capable of receiving and storing “Toll rate table” sent by “Toll Management Center Server”

- The system shall be capable of receiving and storing “Toll rate table” sent by “Toll Management Center Server”

- The equipment of component is capable of transmit the image of vehicle license number plate to “Image Recognition Processor”.

- The equipment of component is capable of accumulate the relative information of enforcement (include image) on the database. The information is shown on Table 8.3.

- Enough capacity of accumulation shall required. (ex. 50,000 vehicles / day, 12months)

Table 8.3 Data Set and Principal Data Elements for Enforcement Assistance

Data Set	Principal Data Element	Update Cycle	Storage Period
Enforcement Record data Set	Tollgate ID	Each vehicle passing	1 year
	Lane server ID	Each vehicle passing	1 year
	Date/time	Each vehicle passing	1 year
	IC-Card ID	Each vehicle passing	1 year
	OBU ID	Each vehicle passing	1 year
	Vehicle class (by OBU)	Each vehicle passing	1 year
	License number (by OBU)	Each vehicle passing	1 year
	License number (by scan)	Each vehicle passing	1 year
	Enforcement Status	Each vehicle passing	1 year
	License plate image data	Each vehicle passing	1 year

- The system shall be capable of displaying extract information from the target accumulated image data and recognition results by using search conditions,. The minimum search conditions are as follow,
  - Tollgate ID
  - Lane Serve ID
  - Licence number (fuzzy reference)
  - OBU ID
  - Date and time of get images

- The equipment components shall be capable of displaying the list of the Vehicle/OBU which License number of each vehicle stored in OBU for comparing with License number

scanned by scanner.

- The following backup shall be done for system backup.

  [Continuous data protection backup]
  (1) Backup is to restore HDD of Data Server when it is being crushed
  Using the manipulation such as RAID to usually store data alike in the same section of HDD

  [Full + Incremental backup]
  (2) Backup is to restore data in the case of data lost in Data Server
  Make a copy of all data in Data Server then stored in another HDD monthly and daily back up the changes as compared to the backup the day before

  [Full System backup]
  (3) Copy and storage all software and data of Toll Management Server.

- System shall be capable of extracting necessary information from Transaction Data, Toll collection data is stored in Data Server based on search criteria which is input from Data Input Device, then displaying on Monitor Screen. The minimum search criteria are as follow:
  - IC-Card ID
  - OBU ID
  - ID of Toll gate
  - ID of Toll lane
  - Name of toll gate
  - Vehicle information (such as Vehicle class, Number Plate and etc)
  - Date and time

- The system shall be capable of displaying the retrieve results on the monitor screen.

- The system shall be capable of printing information which is displayed on Monitor Screen.

- Recommended size of monitor screen shall be 20inchs (approx.) or over.

- All consoles shall have user-friendly interface.

- The system shall be capable of printing retrieved results by A4/A3 type printer.

- The equipment component shall be capable of saving the compiled data in CSV form. It shall be capable of being accessed and modified using commercially application software (such as Microsoft Excel).

- System should have Uninterruptible Power Supply (UPS) to prepare for power failure. Back-up power must be capable for more than 2 hours of power supply.

8.4 Human Machine Interface

- The equipment components shall have the human machine interface for “Operator” to input searching conditions for retrieve the “Transaction data” and “Toll collection data” and for adding and adjusting “Invalidation List”.

8.5 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is TCP/IP.

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

8.6 Installation

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

9. Ambient Conditions

- The equipment component 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 normally operating under the ambient conditions. The conditions shown in Table 7.

Table 9.1 Ambient Conditions

	Temperature	Relative Humidity
Main Center Toll Management Center Toll Office	Average 25 +/- 3 degrees C.	Average 20 – 80 %
Outside	-0 degrees C < < +50 degrees C	Average > 95 %

10. Power Supply

- The main power supply is AC 220 volts single phase and 50 Hz frequency.

- System should have Uninterrupted Power Supply (UPS) to prepare for power failure. Back-up power must be capable for more than 2 hours of power supply

11. Maintainability

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

- The equipment components shall be capable of identifying the faulty parts easily in case it is detected, and the replacement of the parts shall be simple.

- The spare parts of the equipment components shall be available at least five (5) years after the equipment component is handed over to the road management authority, and the manufacturer shall guarantee this spare parts supply period.

- The manufacturer of the equipment components shall submit the necessary documents necessary for the operation and maintenance such as manuals and check list, and necessary training shall be provided to the staffs to be work as O&M staffs of the related equipment components.

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

12. 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.

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

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

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

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

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

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

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

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (18)

OBU Management

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following Documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

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

This Draft General Specifications deal with the equipment components and software to be installed in OBU set-up service shops for actualizing this functional package. This Specifications deal with the equipment components and software to be installed in the OBU registration center 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 5.8GHz (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. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Vehicle Class:** A set of categories of vehicles for toll collection, traffic data or overloading regulation with definition of unique name/identifier to be applied to each category.

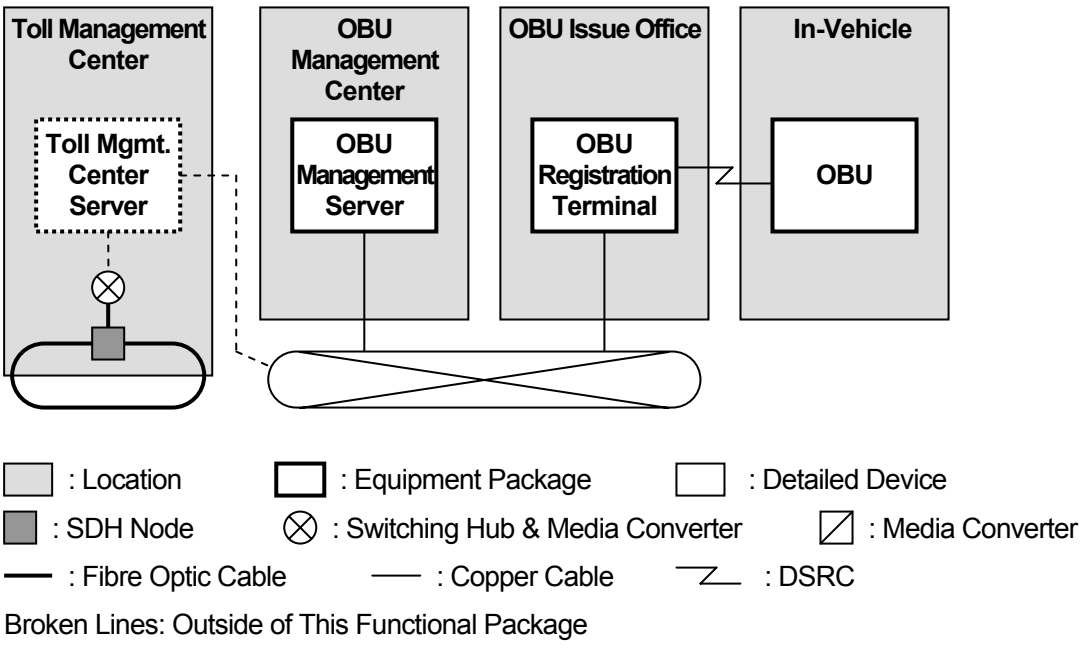
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Data Set:** A set of data elements included in a message with a strong relationship among them.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **Toll Management:** 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 installed in the road management office.
- **OBU Management:** This functional package allows to register on-board units by using equipment installed in OBU issue offices, and allows to generate/manage the registration list and the invalidation list of on-board units by using computers and software installed in the OBU registration center.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **ITU:** The International Telecommunication Union is an agency of the United Nations which regulates information and communication technology issues. ITU coordinates the shared global use of the radio spectrum, promotes international cooperation in assigning satellite orbits, works to improve telecommunication infrastructure in the developing world and establishes worldwide standards.
- **OBU:** On-Board Unit. The in-vehicle device component of an ETC system. A receiver or transceiver permitting the Operator's Roadside Unit (RSU) to communicate with, identify, and conduct an electronic toll transaction; also called a 'transponder' or 'tag.'

- **Node:** A node is a connection point is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel
- **SDH:** Synchronous Digital Hierarchy are standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber using lasers or light-emitting diodes (LEDs). Lower data rates can also be transferred via an electrical interface.

5. Requirements

- The system shall be capable of writing the information of the vehicle (such as OBU ID, Date of issue, License number, Vehicle class) which is equipped by the OBU.
- The system shall be capable of writing the information credibly and securely when the information is written in OBU.
- The system shall be capable of provide the unique ID for the all OBU which is registered in whole country.
- The system shall be capable of transmitting the OBU ID which is registered, to Toll Management Server of each Road operator's.

6. System Architecture



7. OBU (On-Board Unit)

7.1 Functions

- In the case of 2-piece OBU, the IC card to be installed in OBU shall be compliant with ISO/IEC 14443: Contactless Integrated Circuit Card, or ISO/IEC 18092: Near Field Communication – Interface and protocol.

- The OBU shall be capable of recording the data on Contactless IC-Card, such as ID number, usage history information (date, entry and exit IC, the collected toll amount) and prepaid balance information. The stored data are shown in Table 7.1.

Table 7.1 Data Set and Principal Data Elements in "OBU"

Data Set	Principal Data Element	Update Cycle
OBU Registration Data set	OBU ID	OBU registration
	Date of issue	OBU registration
	License number	OBU registration
	Vehicle class	OBU registration

- The system shall be capable of communicating between with OBU and OBU Registration Terminal by radio communication or Contactless IC-Card.

- The equipment of component shall be capable of reading the Prepaid Balance in the IC-Card Recharge Data set of the IC card which is installed in OBU, OBU has the function of reminding the driver in case the balance falls below a certain amount of money.

- The system shall be capable of complying with International Standard.

7.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The equipment component 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 component shall have small size in order not to hinder vision of the operation after the installation,

- The equipment component shall be capable of being firmly installed to avoid being demounted easily.

- The chassis of equipment components shall be capable of absorbing temperature rising from inside equipment and radiant solar heat

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

7.3 Performance

- The communication between “IC-Card” with “OBU” shall be contactless.

- The information included in the card "IC-card" must be encrypted to prevent illegal modification, reading or reporting.

- Encryption method shall be determined 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.

- The equipment of component shall be capable of recording the OBU Registration Data set in the non-volatility memory of OBU.

- The written data in OBU is conducted properly (such as encryption) against illegal reading and writing.

- The equipment component shall be capable of normally operating under the ambient conditions. The conditions are shown in Table 7.2.

Table 7.2 Temperature range, operating

	Temperature	Relative Humidity
In Vehicle	-25 degrees C < < +85 degrees C	Average < 95 %

7.4 Human Machine Interface

- The equipment of component shall be capable of reading the Prepaid Balance in the IC-Card Recharge Data set of the IC card which is installed in OBU, OBU shall have the function of reminding the driver in case the balance falls below a certain amount of money.

7.5 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is 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 capable of being disclosed in order to secure the interoperability of devices. Furthermore, they shall be capable of being disclosed promptly based on the disclosing demand including the contents that are not described here.

7.6 Installation

- The equipment of component shall be capable of being installed easily in the appropriate position in vehicle where the communication between the vehicle and the Roadside Antenna is possible, for example, on the dashboard or window, etc.

- The power of OBU shall basically rely on Internal Battery, the utilisation of Vehicle Battery is optional.

8. OBU Registration Terminal

8.1 Functions

- The equipment component shall be capable of providing the unique ID for the all OBU which are registered in any place over the country.

- The equipment component 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 on the database.

- The equipment component shall be capable of outputting and displaying the Vehicle class, which is identifying in accordance with Vehicle Classification for toll collection of Ministry of Finance.

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

8.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment components shall be capable of absorbing temperature rising from inside equipment.

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

8.3 Performance

- The equipment component shall be capable of requesting the OBU ID issuance to “OBU Management Server” at the time of initial registration of OBU.

- The equipment component shall be capable of receiving the OBU ID from “OBU Management Server” which is responded and transmitted in answer for the request of OBU ID issue.

- The equipment component shall be capable of transmitting the OBU ID which is registered, to Toll Management Server of each Road operator’s.

- The equipment component shall be capable of writing the information of the vehicle (such as OBU ID, Date of issue, License number, Vehicle class) which is equipped by the OBU. The written information is shown on Table 8.1.

Table 8.1 Data Set and Principal Data Elements

Data Set	Principal Data Element	Update Cycle
OBU Registration Data set	OBU ID	OBU registration
	Date of issue	OBU registration
	License number	OBU registration
	Vehicle class	OBU registration

- The equipment component shall be capable of making encryption the OBU Registration Data set when it is written in the OBU.

- The equipment component shall be capable of communicating between with OBU and OBU Registration Terminal by radio communication or Contactless IC-Card.

- The equipment component shall be capable of transmitting the registered OBU Registration Data set, information of the Vehicle and User's information to "OBU Management Server".

8.4 Human Machine Interface

- The equipment component shall have the human machine interface for displaying and inputting the information.

8.5 Communication Interface

- The system shall be capable of controlling the signal for images transmitting in the Ethernet, communication protocol is 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.

8.6 Installation

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

9. OBU Management Server

9.1 Functions

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

- The equipment component shall be capable of indicating unique OBU ID for checking registered OBU ID.

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

9.2 Structure

- The equipment components shall have adequate structure, shape, size, lightweight and robustness.

- The equipment components shall be protected with the measures against lightning.

- The chassis of equipment components shall have adequate structure so as it can not be opened easily, and its door shall be locked.

- The chassis of equipment components shall be capable of absorbing temperature rising from inside equipment .

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

9.3 Performance

- The equipment component shall be capable of transmitting the unique OBU ID for the request of OBU ID issue from “OBU Registration Terminal”.

- The equipment component shall be capable of receiving the registered OBU Registration Data set, information of the Vehicle and User’s information from “OBU Management Server”. OBU Registration Data set is shown in Table 9.1.

Table 9.1 Data Set and Principal Data Elements

Data Set	Principal Data Element	Update Cycle
OBU Registration Data set	OBU ID	OBU registration
	Date of issue	OBU registration
	License number	OBU registration
	Vehicle class	OBU registration

- The equipment component shall be capable of recording the OBU Registration Data set, information of Vehicle and User's information in the database.

- The equipment component shall be capable of avoiding issuing duplication of OBU ID absolutely.

- The equipment component shall be capable of retrieving the relevant information from the database.

- The equipment component shall be capable of printing and displaying the retrieved information.

9.4 Human Machine Interface

- The equipment component shall be capable of equipping the human machine interface for displaying and input the information

9.5 Communication Interface

- The system shall be capable of transmitting the signal for images in the Ethernet, communication protocol is 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.

9.6 Installation

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

10. Ambient Conditions

- The equipment component 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 normally operating under the ambient conditions. The conditions are shown in Table 10.1.

Table 10.1 Ambient Conditions

	Temperature	Relative Humidity
Main Center Toll Management Center Toll Office	Average 25 +/- 3 degrees C.	Average 20 – 80 %
Outside	-0 degrees C < < +50 degrees C	Average < 95 %

11. Power Supply

- The main power supply shall be AC 220 volts single phase and 50 Hz frequency.

- The system shall have Uninterrupted Power Supply (UPS) against power failure. UPS must be capable of providing power for the system for more than 2 hours.

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 road management authority, and the manufacturer shall guarantee this spare parts supply period.

- The manufacturer of the equipment components shall submit the necessary documents necessary for the operation and maintenance such as manuals and check list, and necessary training shall be provided to the staffs to be work as O&M staffs of the related equipment components.

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

13. 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.

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

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

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

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

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

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

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

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

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (19)

Axle Load Measurement

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

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

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, for actualizing this functional package.

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

4. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Heavy Truck Control:** An ITS user service for eliminating overloading of heavy trucks by automatic weighing at interchanges, restraining damage to the road structure, improving safety of the freight trans-port and restraining congestion caused by heavy trucks.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **CCTV Monitoring:** This functional package allows the road operators to capture current

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

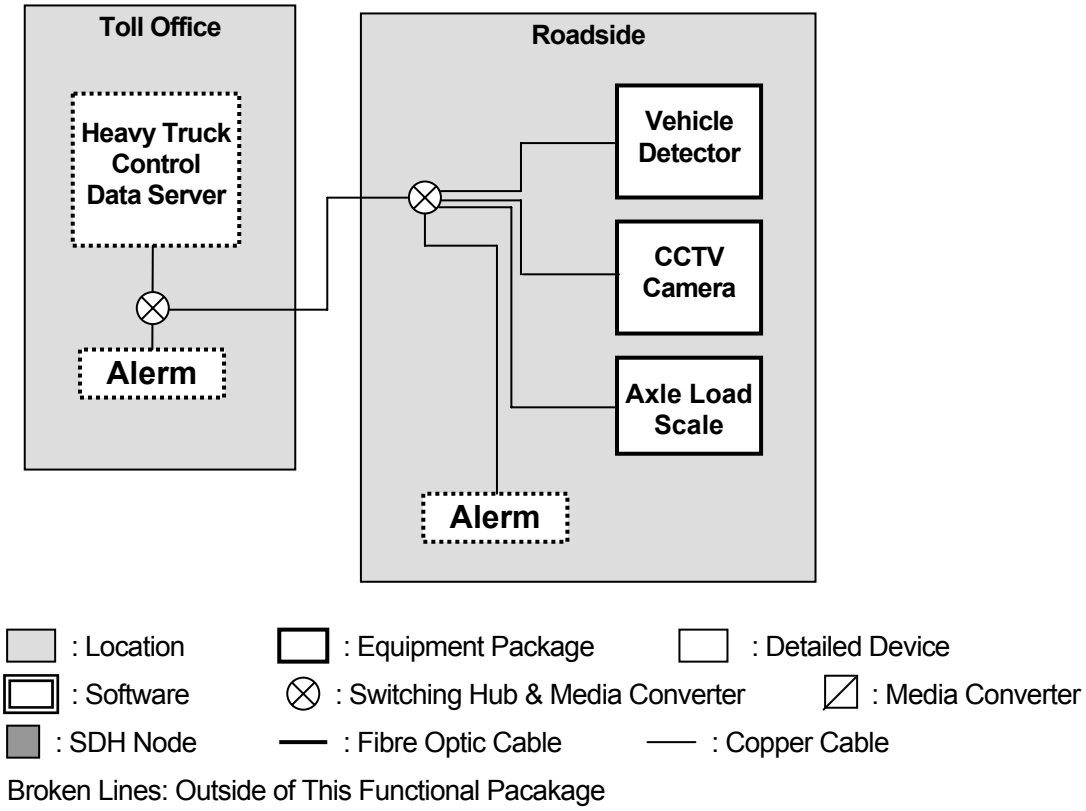
- **Vehicle Detection:** This functional package allows the road operators to measure actual traffic volume, heavy vehicle ratio and vehicle velocity on the expressways for developing road operation/ improvement plans by using vehicle detectors installed at important points on the throughway and the tollgates.
- **Axle Load Measurement:** 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.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **CCTV Camera:** Closed-Circuit Television Camera, which is used for producing images or recordings for surveillance purposes, and can be either video camera, or digital stills camera. Video cameras are either analogue or digital, so that they work on the basis of sending analogue or digital signals to a storage device such as a video tape recorder or computer. Video cameras are network cameras or IP cameras when embedded a video server having an IP address for video and audio streaming.
- **Vehicle Detector:** A sensor either embedded in the pavement or mounted above the expressway to provide vehicle volume, speed, counts, headway, queue lengths, and vehicle classifications.
- **Axle Load Scale:** a scale permanently installed in a fixed location, having a load receiving element specially adapted to determine the combined load of all wheels (1) on a single axle or (2) on a tandem axle of a expressway vehicle.

5. Requirements

- System shall be capable of measuring the number of axles and axle loads of vehicles in motion and investigating overloading.
- System shall be capable of notifying the detection of overloaded vehicle to the operator.
- System shall be capable of generating/storing identification data of overloaded vehicles.
- System shall be capable of indicating and printing out the needed results.
- System shall be capable of installing roadside equipment adequately in a tollgate lane and a dedicated space.

- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

6. System Architecture



7. Axle Load Scale

7.1 Functions

- The axle load scale equipment components are to be composed of axle load measurement function and roadside processing function such as data logger.

- The axle load measurement equipment components shall be capable to measure each axle weight and number of axles when the heavy truck is passing through the axle load measurement system zone without stopping where it is installed closely back from exit tollgate of expressway which is dedicated for heavy truck. The toll island is extended up to the starting point of the measurement zone. (Weigh – in – Motion).

- The axle load measurement equipment components and vehicle detector shall be synchoronized and the measured result shall be verified with the corresponding heavy truck photo to be taken during axle load measurement.

- The axle load measurement equipment components shall be capable to detect failure of the equipment component whenever it happens. The detected failure shall be identifiable.

- Roadside processing function shall be capable to collect measured axle load raw data and vehicle detection result.

- Roadside processing function shll be capable to convert collected measurement result to arithmetic data.

- Roadside processing function shall be capable to link converted measured result of axle load and vehicle detection data as one (1) heavy truck data, including identifying number of axles for one (1) heavy truck.

- Roadside processing function shall be capable to store prcessed data at least two (2) hours temporary.

- 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 function such as “999” to show it as “unknown” if received data is definitely out of measurement range.

- The equipment components to be realized roadside processing function shall be capable to detect failure of the equipment component whenever it happens. The detected failure shall be identifiable.

7.2 Structure

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

7.3 Performance

- The axle load measurment equipment component shall be capable of measuring up to 20 tons.

- The axle load measurement equipment component shall be capable to measure the load within the accuracy shown in the next item under 40km/h heavy truck driving speed.

- The Axle load and heavy truck weight shall be capable to measure within accuracy of 10% for 95% measured results.

- The above accuracy is measuring equipment component's one. It shall not include the error due to road surface dent made by track.

- Roadside processing function shall be completed its process under the conditions that within the time for heavy truck's passing through the axle road measurement system zone, the alert of overloading shall be issued including the processing time of Heavy Truck Control Data Server.

7.4 Human Machine Interfaces

- The operation conditions of axle load measurement equipment components shall be capable to be cheked through the roadside processing function such as data logger to be connected to the measurement equipment components. The roadside equipment component shall be equipped necessary Human Machine Interface for it.

7.5 Communication Interfaces

- Communication interfaces shall be properly selected so as to function well on data and signal transmission between axle load measurement equipment components and roadside processing function such as data logger.

7.6 Installation

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

8. CCTV Camera

8.1 Functions

- Functions for CCTV camera shall be refereed to the “General Specifications for CCTV Monitoring”. The followings are additional functions related to the Axle Load measurement.

- The CCTV camera shall be capable to collect the heavy truck information during its passing through the axle load measurement system zone. The heavy truck information means photo(s) of licence plate number and heavy truck front part.

- In case, some image taken by CCTV camera is not vehicle, for example operation staff or animal, it shall be properly processed without affecting the linkage of other measured result of axle load and corresponding heavy truck information in the Heavy Truck Control Data Server in toll office.

- The CCTV camera and vehicle detector shall be synchoronized.

8.2 Structure

- Structure of CCTV camera shall be refereed to the “General Specifications for CCTV Monitoring”.

8.3 Performance

- Performance of CCTV camera shall be refereed to the “General Specifications for CCTV Monitoring”. The followings are additional performances related to the Axle Load measurement.

- The quality of photo taken by CCTV camera shall be kept enough to recognize its license plate number.

- If lighting is used, it shall not pose an impediment for driver performance for all passing vehicles.

8.4 Human Machine Interfaces

- If some failure happens on CCTV camera, Heavy Truck Control Data Server shall be capable to detect it.

8.5 Communication Interfaces

- Communication interfaces of CCTV camera shall be refereed to the “General

Specifications for CCTV Monitoring".

8.6 Installation

- Installtion of CCTV camera shall be refereed to the "General Specifications for CCTV Monitoring". The following is additional item related to the Axle Load measurement.

- The equipment component shall be protected from the lightning strike and lightning serge. 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. Vehicle Detector

9.1 Functions

- Functions of vehicle detector shall be refereed to the "General Specifications for Vehicle Detection". The followings are additional items related to the Axle Load measurement.

- The vehicle detector shall be installed at the place where the axle load measure and it shall be capable to identify the one (1) vehicle of each passing vehicle.

- The axle load measurement equipment component and vehicle detector shall be synchoronized and the measured result shall be verified with the corresponding heavy truck photo to be taken during axle load measurement.

- The vehicle detector shall be detected failure of the equipment component whenever it happens. The detected failure shall be identifiable.

9.2 Structure

- Structure of vehicle detector shall be refereed to the "General Specifications for Vehicle Detection".

9.3 Performance

- Structure of vehicle detector shall be refereed to the "General Specifications for Vehicle Detection".

- Vehicle detector is to be referred to the General Specifications for Vehicle Detection.

9.4 Human Machine Interfaces

- If some failure happens on vehicle detector, Heavy Truck Control Data Server shall be capable to detect it.

9.5 Communication Interfaces

- Communication interfaces of vehicle detector shall be refereed to the “General Specifications for Vehicle Detection”.

9.6 Installation

- Installtion of vehicle detector shall be refereed to the “General Specifications for Vehicle Detection”. The following is additional item related to the Axle Load measurement.

- Vehicle detector is to be referred to the General Specifications for Vehicle Detection.

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

10. Ambient Conditions

- In case the equipment component such as controllers or data logger is to be installed at outside, it shall be installed in the cabinet or chassis of IP66 or equivalent in order to secure the performance of the equipment component.

- The axle load sensor shall be robust enough to resist heavy truck passage on it because it is buried in the lane of axle load measurement system.

11. Power Supply

- The electric power supply for axle load measurement equipment components shall be equipped the back up power supply for securing continuous operation of the equipment components except for the maintenance period.

12. Maintainability

- The equipment components shall be maintained easily and simply

- The axle load measurement equipment components and related system shall be capable to identify the faulty parts easily in case it is detected, and the faulty parts shall be replacable.

- The spare parts of axle load measurement equipment components and related system shall be available at least five (5) years after the equipment components are handed over to the road management authority, and the supply period of the spare parts shall be guaranteed by the manufacturer.

- The manufacturer of the axle load measurement equipment components and related system shall submit the necessary documents required for the operation and maintenance such as manuals and check list, and provide necessary training to Operation and Maintenance staffs of the related equipment components.

- The manufacturer/supplier of the axle load measurement equipment components and related system 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/supplier shall provide the necessary services based on the contract.

13. 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.

- The axle load measurement equipment component shall be verified before delivery, and the contractor/manufacturer shall be delived with certificate of verification.

14. Testing/Inspection

1) General

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

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

(2) There are two types of test such as factory test and connection test of axle load measurement system and overloading management system. The connection test includes both axle load measurement and overloading management equipment components and related systems such as alerm, vehicle detector, CCTV camera, etc.

(3) As for the inspection, the connection inspection is to be witnessed basically.

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation

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

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

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

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (20)

Overloading Management

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

This functional package allows the road operators to store/retrieve data of the heavy trucks overloaded on the expressways by using computers and software installed in the road management office.

2. Scope

This Draft General Specifications deal with the equipment components and software to be installed in the Main Centers of the expressway network for actualizing this functional package.

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

4. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **ITS User Service:** A service to be provided by an ITS application to the users directly or indirectly.
- **Heavy Truck Control:** An ITS user service for eliminating overloading of heavy trucks by automatic weighing at interchanges, restraining damage to the road structure, improving safety of the freight trans-port and restraining congestion caused by heavy trucks.
- **Incident:** An unusual and unplanned event that affects or impedes the normal flow of traffic, such as traffic accidents, broken-down vehicles, left obstacles, reversing vehicles, vandalism and natural disaster on the road.
- **Traffic Restriction:** A limitation on the road transport, such as closure, lane restriction,

speed restriction and warning information.

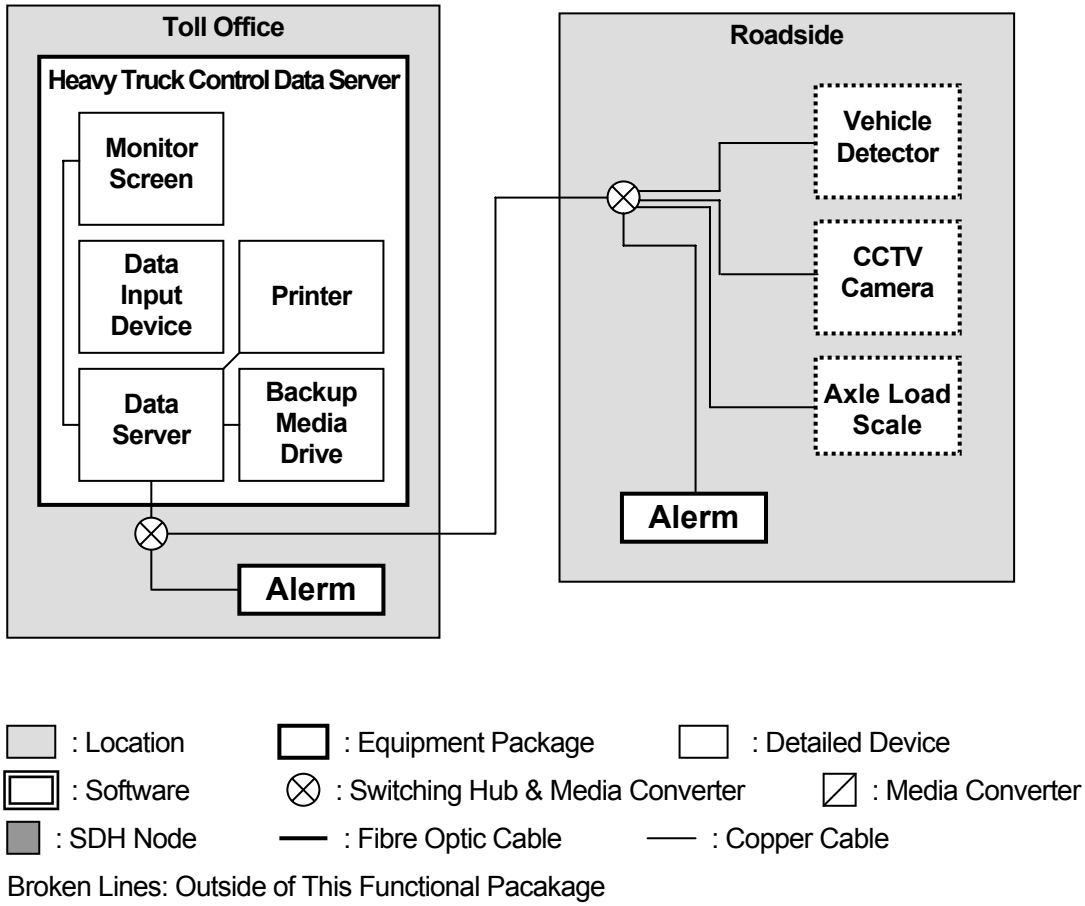
- **Vehicle Class:** A set of categories of vehicles for toll collection, traffic data or overloading regulation with definition of unique name/identifier to be applied to each category.
- **Main Center:** The Center in charge of traffic monitoring, traffic control and traffic information dissemination, and is to be cooperated with road management offices.
- **Road Management Office:** An office in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring equipment for surveillance.
- **Toll Office:** A toll office is located at a tollgate, which includes two or more tollbooths, and is in charge of toll collection.
- **Draft General Specifications:** The Draft General Specifications defines required processing functions, performance, interfaces and installation of equipment in order to establish compatibility of equipment components.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Message:** A set of data to be exchanged between subsystems for transferring information.
- **Data Element:** A unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes.
- **Vehicle Identification:** This functional package allows the road operators to identify individual vehicle by using a license plate scanner and other equipment installed in a separated lane such as a tollgate lane of the expressway.
- **Axle Load Measurement:** 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.
- **Overloading Management:** This functional package allows the road operators to store/retrieve data of the heavy trucks overloaded on the expressways by using computers and software installed in the road management office.

- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **ITU:** The International Telecommunication Union is an agency of the United Nations which regulates information and communication technology issues. ITU coordinates the shared global use of the radio spectrum, promotes international cooperation in assigning satellite orbits, works to improve telecommunication infrastructure in the developing world and establishes worldwide standards.
- **CCTV Camera:** Closed-Circuit Television Camera, which is used for producing images or recordings for surveillance purposes, and can be either video camera, or digital stills camera. Video cameras are either analogue or digital, so that they work on the basis of sending analogue or digital signals to a storage device such as a video tape recorder or computer. Video cameras are network cameras or IP cameras when embedded a video server having an IP address for video and audio streaming.
- **Axle Load Scale:** a scale permanently installed in a fixed location, having a load receiving element specially adapted to determine the combined load of all wheels (1) on a single axle or (2) on a tandem axle of a expressway vehicle.

5. Requirements

- System shall be capable of storing all data prepared for investigating overloading in a database.
- System shall be capable of generating the data of forms for overloading regulation and storing them in a database.
- System shall be capable of listing the identification data of overloaded vehicles as a negative list.
- System shall be capable of securing sufficient durability and reliability of equipment components in the ambient conditions at roadside.

6. System Architecture



7. Heavy Truck Control Data Server

7.1 Functions

- Heavy Truck Control Data Server in Toll Office shall be capable to record measured result of each axle weight and number of axles obtained by axle load measurement equipmentcomponents.

- 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.

- The measurement result and calculation result for heavy truck gross weight, each axle load, and number of axles of heavy truck shall be recorded as one vehicle data in the Heavy Truck Control Data Server for all paasing vehicles of the axle load measurement system zone.

- The vehicle information of license plate number and photo of vehicle front part obtained by the CCTV camera system shall be recorded into the Heavy Truck Control Data Server for all passing heavy trucks with corresponding heavy truck's measured and calculated results.

- In case, some image taken by CCTV camera is not vehicle, for example operation staff or animal, it shall be properly processed without affecting the linkage of other measured result of axle load and corresponding heavy truck information in the Heavy Truck Control Data Server in toll office.

- In case, the measured axle load and/or heavy truck weight exceed the threshhold, 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 into consideration specified weight in Circular 07/2010/TT-BGTVT and measuring equipment component error.

- 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 print out in one sheet with appropriate form for such vehicle.

- The Heavy Truck Control Data Server shall be capable to check on synchronization between axle load measurement equipment components and vehicle detector.

- In case, the measured axle load and/or heavy truck weight exceed the threshhold, 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 farther location of the axle load measurement system zone.

- The recorded data on heavy truck in Heavy Truck Control Data Server shall be serchable. The serch result shall be capable to display on the screen with the list form of measured result and calculation result such as heavy truck weight, axle load, number of axles, licensing plate number, front part photo of corresponding vehicle, and photo of license plate namber.

- 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 print out in one sheet with 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 alerm. The detected failure shall be identifiable.

7.2 Structure

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

7.3 Performance

- The Heavy Truck Control Data Server shall be capable enough to perform necessary functions stipulated in item 7.1.

- The Heavy Truck Control Data Server shall be synchronized with all roadside equipment components

- The vehicle number recognition rate from the vehicle photo shall be 95% or more under the conditions of recognizable shown in the design standard of Heavy Truck Control.

- 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.

7.4 Human Machine Interfaces

- The Heavy Truck Control Data Server shall be equipped necessary human mashine interface such as monitor screen, key board and mouse.

- Human mashine interface, which is able to notify alert to the operator or staff when measured result of axle load and/or heavy truck gross weight exceed the threshold, shall be equipped in toll office. The alerm is to be buzzer, flashing light, or specific display on monitor screen.

7.5 Communication Interfaces

- Communication interfaces shall be properly selected so as to function well on data and signal transmission between different equipment components such as between data logger which collects axle load measurement result at roadside and Heavy Truck Control Data Server to be located in the toll office.

7.6 Installation

- Weather Data Server shall be installed in air conditioned room in Main Center building.

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

8. Alerm Notification

8.1 Functions

- In case, the measured axle load and/or heavy truck weight exceed the threshhold, 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 farther location of the axle load measurement system zone.

8.2 Structure

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

8.3 Performance

- The alerm 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 around the end of the axle load measurement system zone.

8.4 Human Machine Interfaces

- The alerm notification equipment component to be installed each lane of the axle load measurement system zone shall be capable to notify the alert to the operator who monitors heavy trucks around the end of the zone.

- The alerm notification for the operator who monitor the monitor screen of the Heavy Truck Control Data Server shall be buzzer or appropriate screen display.

8.5 Communication Interfaces

- Communication interfaces shall be properly selected so as to function well on signal transmission between Heavy Truck Control Data Server and alert equipment components.

8.6 Installation

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

9. Ambient Conditions

- The overloading management equipment components shall be accommodated in the air conditioned clean room or chassis (equivalent to IP65 or better) to keep the performance of the equipment components.

- The spare parts related to the overloading management equipment components shall be accommodated in the air conditioned clean room (equivalent to IP66 or better) to keep the performance of it.

10. Power Supply

- The electric power supply for overloading management equipment components shall be equipped back up power supply for securing continuous operation of the equipment components except for the maintenance period.

11. Maintainability

- The equipment components shall be maintained easily and simply

- The Heavy Truck Control Data Server shall be capable to conduct self-diagnosis.

- The overloading management equipment components shall be available at least five (5) years after the equipment components are handed over to the road management authority, and the supply period of the spare parts shall be guaranteed by the manufacturer.

- The manufacturer of the overloading management equipment components shall submit the necessary documents required 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 overloading management 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/supplier shall provide the necessary services based on the contract.

12. 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.

- The manufacturer shall be required to have some similar experiences of developing software for Heavy Truck Control Dafta Server specified above, and the manufacturer shall be required to submit the copy of the evidenced document of the successful delivery such as certificate of completion issued by the client attached with tender or prequalification proposal. In addition, several screen image of the delivered software shall be also submitted with the list of similar project experience attached with the tender or prequalification proposal.

13. Testing/Inspection

1) General

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

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

(2) There are two types of test such as factory test and connection test of axle load measurement system and overloading management system. The connection test includes both axle load measurement and overloading management equipment components and related systems such as alerm, vehicle detector, CCTV camera, etc.

(3) As for the inspection, the connection inspection is to be witnessed basically.

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

(3) The test and inspection procedure of the connection test shall be submitted to the road

management authority and the consultant

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4)The necessary number of submission documents

DRAFT GENERAL SPECIFICATIONS (21)

Center/Roadside Communication

(Ver.1.0: Final Version of the Study Results)

Documents and Volumes of Draft ITS Standards

The Draft ITS Standards consist of the following documents:

- Draft Design Standards (volumes organized by the ITS user services)
- Draft General Specifications (volumes organized by the functional packages)
- Draft Message/Data Standards
- Draft Communication System Plan

The Draft ITS Standards organized by 26 volumes shown below.

Draft Design Standards (3 Volumes)	(1) Traffic Information/Control (2) Automated Toll Collection	(3) Heavy Truck Control
Draft General Specifications (21 Volumes)	(1) Telephone Exchange (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) Lane Monitoring (13) Vehicle/Class Identification (14) Lane Control (15) Road-to-Vehicle Communication (16) IC-card Recording (17) Toll Management (18) OBU Management (19) Axle Load Measurement (20) Overloading Management (21) Center/Roadside Communication (including Ducts)
Draft Message/Data Standards (1 Volume)	Message List	Data Dictionary
Draft Communication System Plan (1 Volume)	General Communication System Plan	Design Standards of Communication System

TABLE OF CONTENTS

1. General Outlines

This functional package allows the road operators to exchange data for ITS among the main centers, the road management offices and pieces of roadside equipment by using the backbone network among the centers, which comprises fibre optic cables installed in the shoulder along the expressways and communication nodes, and access network between communication nodes and roadside terminals.

2. Scope

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

3. Relevant Regulations and Standards

ITU-T G.803: Architecture of transport networks based on the synchronous digital hierarchy (SDH)
ITU-T G.703: Physucal/electrical characteristics of hierchical digital interface
ITU-T G.652: Characteristics of single-mode optical fibre cable
ITU-T G.655: Characteristics of a non-zero dispersion shifted single-mode optical fibre cable
ITU-T G.114: One-way transmission time
ITU-T H.320: Standards for video conferencing
ITU-T H.323: Visual telephone systems and equipment for local area networks which provide a non-guaranteed quality of service

IEEE 802.3: Ethernet (Carrier Sense Multiple Access with Collision Detection)
ITU-T Y.1541 Network performance objectives for IP-based services

BS 7430: Earthing
BS 6651: Lightning Protection

4. Definitions of Terms

- **ITS:** Intelligent Transport Systems (ITS) are systems to support transportation of goods and humans with information and communication technologies in order to efficiently and safely use the transport infrastructure and transport means (cars, trains, planes, ships...)
- **Traffic Information/Control:** An ITS user service for providing accurate surveillance of

traffic conditions on the roads, assisting prompt action of the road operator and emergency vehicles by notifying occurrences of traffic accidents, significant weathers and traffic congestions, allowing the road operator to control road traffic and the drivers to avoid the influence of the incidents by providing accurately updated information.

- **Road Management Office:** An office in charge of patrol for surveying current traffic conditions on the expressway, and is to be equipped with the operation vehicles and the monitoring equipment for surveillance.
- **System Architecture:** Diagrams indicated by the combination of subsystems and interfaces necessary for realizing a large system such as ITS. That should consist of several different kinds of diagrams, such as collaboration diagrams and message sequence diagrams in the notation of UML (Unified Modelling Language).
- **Equipment Component:** The lowest subsystem of the system architecture, which is defined as the ordering unit for suppliers. Particulars of the Draft General Specifications are to be set up corresponding to the equipment components.
- **Functional Package:** A group of subsystems that have strong relationship to realize a certain function. Particulars of the Draft Design Standards and volumes of the Draft General Specifications are to be set up corresponding to the functional packages.
- **Interface:** A connection for distributing information between two different subsystems, or between a subsystem and an object outside of ITS, and that is important target for discussing the standardization.
- **Toll Management:** 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 installed in the road management office.
- **Center/Roadside Communication (Including Ducts):** This functional package allows the road operators to exchange data for ITS among the main centers, the road management offices and pieces of roadside equipment by using the backbone network among the centers, which comprises fibre optic cables installed in the shoulder along the expressways and communication nodes, and access network between communication nodes and roadside terminals.
- **ISO:** The International Organization for Standardization is an international-standard-setting body composed of representatives from various national standards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary industrial and commercial standards.
- **ITU:** The International Telecommunication Union is an agency of the United Nations which regulates information and communication technology issues. ITU coordinates the shared global use of the radio spectrum, promotes international cooperation in assigning satellite orbits, works to improve telecommunication infrastructure in the developing world and establishes worldwide standards.
- **CCTV Camera:** Closed-Circuit Television Camera, which is used for producing images or

recordings for surveillance purposes, and can be either video camera, or digital stills camera. Video cameras are either analogue or digital, so that they work on the basis of sending analogue or digital signals to a storage device such as a video tape recorder or computer. Video cameras are network cameras or IP cameras when embedded a video server having an IP address for video and audio streaming.

- **NVR:** A completed hardware box or software only that receives digital video streams and images from network cameras and records them onto a data storage device. Recording, playback, and panning, tilting, zooming for PTZ cameras is controlled remotely via a network computer.
- **Event Detector:** A software application that uses computer algorithms to uses computer algorithms to intelligently monitor real-time video for automatically detecting incident occurrences and their types, such as traffic accidents, breakdown vehicles, left obstacles, driving in the reverse direction, vandalism and natural disasters.
- **Vehicle Detector:** A sensor either embedded in the pavement or mounted above the expressway to provide vehicle volume, speed, counts, headway, queue lengths, and vehicle classifications.
- **Weather Sensor:** A sensor installed at a specific point on the road for measuring rainfall, wind speed, visibility, air temperature and road surface temperature.
- **VMS:** Variable Message Sign, which is an electronic sign installed along or above expressway and other highways that provide dynamic messages to alert the motoring public of incidents, congestion, construction, or other information. VMS is also known-as Changeable Message Sign and Dynamic Message Sign.
- **Image Recognition:** Software technology that uses computer algorithms to intelligently monitor real-time video for automatically recognizing license plate number of vehicle, vehicle speed, the occurrence of traffic accidents, broken-down vehicles, and left obstacles.
- **Conduit:** A piping system used for protection and routing of network cables. Conduit may be made of metal, plastic, fiber, or fired clay. Flexible conduit is available for special purposes.

5. Requirements

- System shall be capable of exchanging data including video image among roadside equipment on the expressways, the Main Center and road management offices.

- System shall be capable of transmitting interactive voice communications between Main Center, road management offices and toll management offices.

- System shall be capable of transmitting directives to the units concerned simultaneously and on a top-priority at any time for clearing incidents and enforcing traffic regulations.

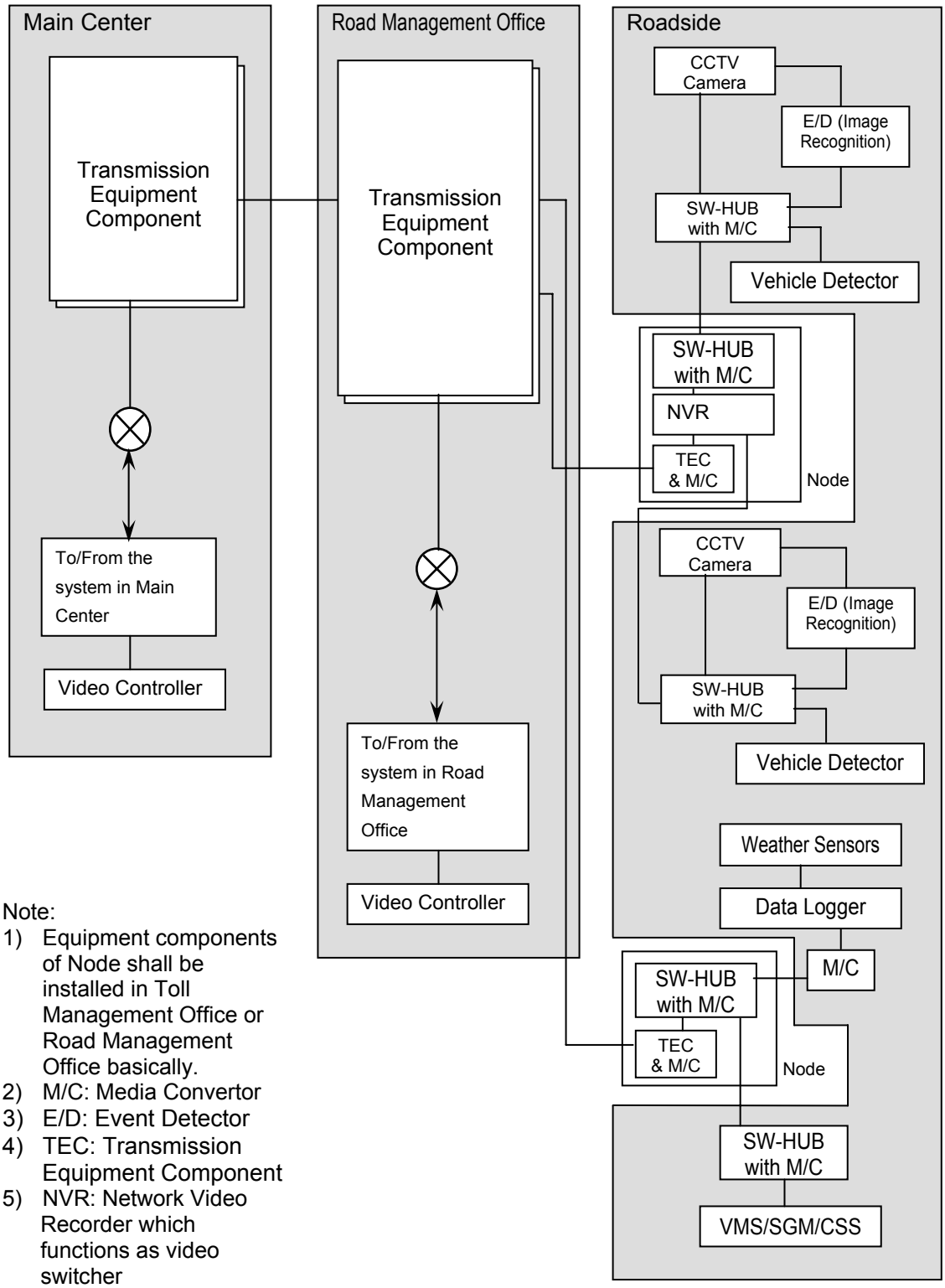
- System shall be capable of identifying location of problems that occurres on communication network and of recovering them by automatically switching network.

- System shall be capable of functioning 24 hours a day, 365 days a year by a redundant system and sufficient durability/reliability of equipment components.

- 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 with making clear system demarcation point and each responsibility.

6. System Architecture

1) Center/Roadside Communication System related to Traffic Information/Control



Note:
1) Equipment components of Node shall be installed in Toll Management Office or Road Management Office basically.
2) M/C: Media Convertor
3) E/D: Event Detector
4) TEC: Transmission Equipment Component
5) NVR: Network Video Recorder which functions as video switcher

7. Transmission Equipment Component

7.1 Functions

- The transmission equipment components shall be secured to transmit the directive communications during the emergency cases.

- The transmission system shall be complied with the international standard.

- The transmission equipment components shall equip the function of mapping the obtained data from CCTV Camera, detector, sensor, or servers so as to be able to transmit it, and also shall equip the function of demapping the transmitted data from the transmission channel so as to be able to utilize it for servers or disseminating equipment components such as VMS.

- The fault of the transmission equipment components shall be detected by the network management system and shall be capable to notify it to the operating staff. During emergency repairing time after detection of the network fault, redundant equipment component shall be secured so as to capable to operate the network without interruption.

- The transmitting data through the communication network shall be capable of maintaining appropriate security conditions.

- The transmission equipment component shall be those types whose usefulness have been confirmed by road operators, communication carriers or operators in foreign countries except for the original manufacturing country.

7.2 Structure

- The equipment components shall be capable of operating continuously 24 hours a day for 365 days a year.

- The transmission equipment components shall have the structure which is possible to fix in the building or chasses.

- The structure of transmission equipment components shall be capable to replace the faulty parts simply and easily when it is detected.

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

7.3 Performance

- The performance of the transmission equipment components shall be capable to transmit required communication traffic in appropriate timing under the conditions stipulated in the concerned sections of this General Specifications.

- The mentioned required communication traffic includes the data traffic between roadside equipment components and Main Centers and those traffic between Main Center and road management centers, emergency directive communications between Main Center and road management offices, and other interactive voice communications required under normal operation and maintenance.

- As for the directive communications and interactive voice communications, it shall be complied with the conditions of Class 0 of ITU-T Recommendation Y.1541 at least.

- The protocols to be applied shall be Synchronous Digital Hierarchy (SDH), Gigabit Ethernet, or combination of them basically.

7.4 Human Machine Interfaces

- The transmission equipment components shall equip the human machine interface in order for operation and maintenance staff to make diagnosis of the transmission system, input the necessary command, and execute other necessary operation and maintenance activities.

- When the fault of the transmission equipment components is detected by network management system, the function to notify it as alert, such as buzzer or alert screen on the display, to the O&M staff.

7.5 Communication Interfaces

- The interface of the transmission equipment components shall be complied with the international standard, and shall not be hindrance of transmission of data, signal and voice.

7.6 Installation

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

8. Optical Fiber Cable

8.1 Functions

- Optical Fiber Cable is applied for the network whose communication traffic volume is rather large and high transmission speed is required, except for the part of network between roadside equipment component and node. .

- The single mode optical fiber cable to be applied and shall be complied with the international standard.

- The fault of the Optical Fiber Cable shall be detected by the network management system and shall be capable to notify it to the operating staff. During emergency repairing time after detection of the network fault, redundancy shall be secured so as to capable to operate the network without interruption.

- The transmitting data through the communication network shall be capable of maintaining appropriate security conditions.

- The Optical Fiber CAble to be applied shall be those types whose usefulness have been confirmed by road operators, communication carriers or operators in foreign countries except for the original manufacturing country.

8.2 Structure

- The optical fiber cable to be installed in duct is applied basically.

- The optical fiber cable shall have enough capability to resist against rodent.

8.3 Performance

- The optical fiber cable to be applied shall be capable to transmit required communication traffic under the required conditions stipulated in the concerned sections of this General Specifications.

- The mentioned required communication traffic includes the data traffic between roadside equipment components and Main Center and those traffic between Main Center and road management offices, emergency directive communications between Main Center and road management offices, and other administrative telephone calls.

- The measuring instruments to 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 outsourcing to other organization, necessary conditions shall be specified in the outsourcing contract documents.

- The necessary tools to replace the optical fiber cables and jointing tools and materials for the cables shall be provided for the road management organization by the cable manufacturer in order to maintain the cables. 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 outsourcing to other organization, necessary conditions shall be specified in the outsourcing contract documents.

8.4 Human Machine Interfaces

- When the fault of the optical fiber cable is detected by network management system, the function to notify the alert, such as buzzer or alert screen on the display, to the O&M operator shall be equipped.

- The measuring instruments to be used for normal maintenance or fault detected cases of the optical fiber cables such as Optical Time Domain Reflectometer (OTDR), the proper size display to show the measurement result shall be equipped.

8.5 Communication Interfaces

- The interface of optical fiber cable shall be complied with the international standard, and shall not be hindrance of transmission of data, signal and voice.

8.6 Installation

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

9. Ducts Facilities

9.1 Functions

- The duct facilities includes ducts, manhole (MH) and handohole (HH).

- The MH and HH is to be installed where the cable branch, cable joint, and cable installation work is required.

- The duct shall be capable so as to add or replace the cable in future.

9.2 Structure

- The duct shall have proper structure and proper material strength so as not to be deformed with the loadings affecting to the duct, and not to be damaged to the inside cables.

- The duct shall be installed with keeping required covering depth basically. If it is impossible to keep necessary covering depth due to some reasons such as crossing sewage pipe or water conduit, the ducts shall be protected with concrete or concrete with steel plate.

- The MH is a box type structure with slab in which the man works inside, and it connects by neck part between bottom of the frame of the cover and top of the slab which adjusts the height of the cover top to the ground level. The handhole (HH) is rather small box type structure without slab, and the man works on the ground beside the cover of it. The cover is installed on top of the neck part, which connects between cover base and top of the HH wall for adjusting the height of cover top to the ground level.

- The MH and the HH shall be equipped the necessary hardware such as pulling iron for cable installation and cable bracket or cable bearer for cables or splicing enclosure.

- The MH and the HH shall be covered with the required strength of ductile cast iron cover or equivalent.

- The MH shall be kept enough size of the space inside where man is able to work, and at least 60 cm diameter shall be kept inner diameter of the cover and neck part.

9.3 Performance

- The necessary inner diameter of the duct shall be kept so as not to be any difficulty of installation of cables. The sample ducts inside diameter to be required are shown in

the following table.

Outer diameter of cables	Necessary duct inside diameter	Sample ducts type and nominal diameter
37 mm	56 mm	PVC ϕ 50
55 mm	83 mm	PVC ϕ 75
34 mm	50 mm	FEP ϕ 50
54 mm	80 mm	FEP ϕ 80

- The number of ducts to be installed shall be planned taking the following conditions;
  The number of cables to be installed
  The number of cables to be installed in future
  The number of ducts for emergency works
  The number of spare ducts

- The number of ducts for bridge section shall be planned to keep margins so as not to be required to add in future since it is difficult to do so.

- Should it be required additional installation work of ducts in future, the ducts shall be installed in the way of occupancy where it is less affects the driving cars on the expressways so as to be capable to install them.

- The MH and the HH shall have enough internal dimensions for working space of cable installation and splicing, and for spaces to accommodates the installed cables and splice enclosures.

- The MH and the HH shall not be installed at the location where it affects the driving vehicles on the expressways and toll lane, for cable installation work, cable splicing work, and other maintenance works.

9.4 Installation

- It is the fundamental implementation procedure that the duct facilities including MH and HH shall be planned to install at the time of expressways construction period so as not to damage the road structure by installing the ducts with excavation of it.

10. Ambient Conditions

- The transmission equipment components shall be accommodated in the air conditioned clean room or chassis equivalent to IP66 to keep the performance of the equipment components.

- The spare parts of the transmission equipment components shall be accommodated in the air conditioned clean room to keep the performance of it.

11. Power Supply

- The electric power supply for Center/Roadside Communication system shall be equipped the back up power supply for securing the operation of the equipment components of it for 24 hours a day 365 days a year.

12. Maintainability

- The equipment components shall be maintained easily and simply.

- The transmission equipment components 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 transmission equipment components and optical fiber cables 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 transmission equipment components and optical fiber cable shall submit the documents necessary for the operation and maintenance such as manuals and check list, and necessary training shall be provided to the related O&M staffs.

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

13. Quality Control

- The manufacturer of the equipment components shall 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.

14. Testing/Inspection for Transmission Equipment Component and Optical Fiber Cable

1) General

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

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

(2) There are three types of test such as factory test, unit test of the equipment component at site after installation, and connection test of completed transmission network.

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

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

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

2) Tests and Inspections during Project Implementation

The following steps shall be taken during project implementation.

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

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

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

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

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

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

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

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

3) Necessary Document

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

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

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

4) Other Conditions

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

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

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

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

(4) The necessary number of submission documents