APPENDIX 2

Relevant International Standards

APPENDIX-2: Relevant International Standards

Summaries of the following international standards are presented in this appendix.

- ISO/CD 14813: Reference model architecture for the ITS sector
- 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 application layer
- ISO 14906: Application interface definition for DSRC
- ISO/CD 22837: Configuration of vehicle probe for wide area communication
- ISO/CD 24533: Data dictionary and message set for tracking of freight and It's inter-modal transfer
- ISO 14443: Contactless IC-Card
- ISO/IEC 18092: Information technology – telecommunications and information exchange between systems – near field communication – interface and protocol (NFCIP-1).

1) ISO/CD 14813: Reference Model Architecture for the ITS Sector

System architecture is a conceptual design of a whole system. In establishing ITS, a large-scale and long-term system, system architecture is important to make all the people concerned share a picture of the whole system and to ensure interoperability, compatibility and expandability of the system. The ITS reference architecture has been established to serve s reference materials for architectural development in various countries, and as a reference model for comparison of different architecture, such as the OSI layer model.

ISO/CD 14813 consists of six parts as follows:

- Part1: Fundamental services
- Part2: Core reference architecture
- Part3: Example elaboration
- Part4: Reference model tutorial
- Part5: Requirements for architecture description
- Part6: Data presentation in ASN.1.

2) ISO/IEC 11179: Information Technology – Specification and Standardization of Data Elements

International standard ISO/IEC 11179 was prepared by joint technical committee ISO/IEC JTC 1, information technology, SC 14, data element principles. ISO/IEC 11179 consists of the following parts, under the general title Information technology - specification and standardization of data elements:

- Part1: Framework for the generation and standardization of data elements
- Part2: Classification of concepts for the identification of domains
- Part3: Basic attributes of data elements

- Part4: Rules and guidelines for the formulation of data definitions
- Part5: Naming and identification principles for data elements
- Part6: Registration of data elements.

3) ISO/DIS 14817: Transport Information and Control Systems – Requirements for an ITS/TICS Central Data Registry and ITS/TICS Data Dictionaries

This international standard specifies the framework, formats and procedures used to define information exchange within Intelligent Transport System / Transport Information and Control Systems (ITS/TICS) sector. It defines the content of the ITS/TICS central Data Registry and data dictionaries, the registration to enter data concepts into the Data Registry. Throughout the text, the Data Registry should be taken to mean the ITS/TICS central Data Registry.

Specifically, this International Standards specifies:

- Framework used to identify and define all information exchanges
- Framework used to extend standardized information exchanges to support local customizations and combinations
- Information modeling method for defining ITS/TICS data concepts, when used
- the meta attributes used to describe, standardize and manage each of data concepts defined within this framework
- Requirements used to record these definitions
- Formal procedures used to register these definitions within the Data Registry.

The Data Registry described herein supports, and is designed to include, data concepts using alternative International, Regional or National System Architecture methodologies or techniques. A common Data Registry will ease migration and interoperability between such approaches.

4) ITU-R M.1453: DSRC at 5.8GHz (Physical Layer)

This Recommendation outlines the technologies and characteristic for DSRC in the 5.8GHz band. This Recommendation includes both the active (transceiver) method and the backscatter (transponder) method as DSRC technologies available for ITS. The technical and operational characteristics of both are described. DSRC application include ETC (Electronics Toll Collection), parking payment, gas (fuel) payment, traffic information, management pf public transportation and commercial vehicle, fleet management, probe data collection, border crossing and electronic clearance of freight.

- **Active (transceiver) method:** For the active method, on-board units are equipped with the same function as roadside units for radio communication. More specifically, both roadside units and OBU incorporate 5.8GHz band carrier frequency oscillator and have the same functionality for radio transmission.
- **Passive (transponder) method:** In contrast to the active method, OBU for the Passive method does not have an internal oscillator for generating 5.8GHz band radio carrier signal, so it relies on the 5.8GHz oscillator of the roadside unit with which it communicates.

5) ISO 15628: DSRC Application Layer

This standard defines DSRC (Dedicated Short Range Communication) Application Layer equivalent to communication protocol Layer 7. Standardization of the radio communication method equipment to the Physical Layer has been handled by ITU-R, and recommendations on methods, including those of Japan and Europe, have been approved.

Under DSRC, Layers 3-6 are usually omitted so that a vehicle running at a high speed can carry out direct communication with roadside equipment within a limited communication area. Functions necessary in theses layers are included in the application Layer. Various applications are available in DSRC, and as application identifier (AID) identifying application is stipulated in the Application Layer. Roadside or On-Board application processes designate this AID, and carry out communication with the other (on-board or roadside) application processes by way of the Application Layer and lower layer. Communication functions are performed mainly by transfer kernel. The functions include encoding and decoding of information, division and assembly of given frames and multiplexing of application information.

6) ISO 14906: Application Interface Definition for DSRC

This standard specifies the application interface in the context of EFC using DSRC. The EFC application interface is the EFC application process interface to the SARD Application Layer. The scope of this standard comprises specifications of following items.

- EFC attributes (i.e. EFC application information)
- Addressing procedures of EFC attributes and components (e.g. ICC and MMI)
- EFC application functions
- EFC transaction model
- Behavior of the interface

This standard provides security-specific functionality as place holders (data and function) to enable the implementation of secure EFC transaction.

7) ISO/CD 22837: Configuration of Vehicle Probe for Wide Area Communication

A system that consists of a grope of vehicles that collect and transit various types of data using medium and wide area radio communication, and center functions for statistical processing of the received data to acquire information concerning traffic, road and environment is called a “probe vehicle system”. Probe data is the data sent from on-board systems in the vehicle to the centers and other external systems. The sped and other basic data in the probe data are called “probe data element”, and a compilation of multiple data elements is called probe message”. Probe message always contains the position and the time stamps.

For probe data, standardization of the following is in progress:

- Basic work frame
- Reference architecture
- Core data element
- Initial set of probe messages.

8) ISO/CD 24533: Data Dictionary and Message Set for Tracking of Freight and It's Inter-modal Transfer

Subject to this standardization are the data dictionary and message sets to be exchanged between a shipper and several transport organizations in door-to-door transport. Specifically, it involves standardization of data elements used for electronic data interchange (EDI) and message necessary in supply chains.

Door-to-door transport requires international integrated transport involving trucks, railways, ships and airplanes. A different EDI is used for each transport organization. It will take a great deal of time and effort to unify data standardization that differs according to each country and organization, and to introduce rules for standard information exchange.

9) ISO 14443: Contactless IC-Card

Contactless IC card generally means the IC card capable of radio communication within 10 centimeter. The standard ISO 14443 for contactless IC card comprises 5 parts.

- ISO 14443-1: Physical characteristics
- ISO 14443-2: RF power and signal interface
- ISO 14443-3: Initialization and anti-collision
- ISO 14443-4: Transaction protocol
- ISO 14443-5: Test methods

Contact IC card includes Type-A, Type-B and Type-C. Specifications for Type-A and Type-B are in the foregoing ISO 14443-2.

10) ISO/IEC 18092: Information technology – telecommunications and information exchange between systems – near field communication – interface and protocol (NFCIP-1)

"Type-A" and "Felica" are according to this standard. ISO/IEC18092 is standardization of "Communication protocol", "Anti-collision" and "Radio spec". It is not included "Physical characteristics".

ISO/IEC 18092:2004 defines communication modes for Near Field Communication Interface and Protocol (NFCIP-1) using inductive coupled devices operating at the centre frequency of 13,56 MHz for interconnection of computer peripherals. It also defines both the Active and the Passive communication modes of NFCIP-1 to realize a communication network using Near Field Communication devices for networked products and also for consumer equipment. This International Standard specifies, in particular, modulation schemes, codings, transfer speeds and frame format of the RF interface, as well as initialization schemes and conditions required for data collision control during initialization. Furthermore, this International Standard defines a transport protocol including protocol activation and data exchange methods.

Information interchange between systems also requires, at a minimum, agreement between the interchange parties upon the interchange codes and the data structure.

APPENDIX 3

Reference of ITS User Services to ISO14813-1

Appendix 3

Reference of ITS User Services to ISO14813-1

The ITS user services proposed in the Master Plan are corresponding to the services in the ISO14813-1 as enumerated later, where the ITS user services are shown by the numbers:

(a) **<1>:** Traffic Information/Control

(b) **<2>:** Non-stop Toll Collection

(c) **<3>:** Heavy Truck Control

(d) **<4>:** Inter-city Bus Assistance

(e) **<5>:** Convenient Parking Assistance

(f) **<6>:** Road Pricing

1) Traveler Information Service Groups

(1) Pre-trip Information

- Pre-trip information – Traffic and roadway <1>
- Pre-trip information – Public transport (bus and rail) <4>
- Pre-trip information – Commercial vehicle
- Pre-trip information – Personal interactive
- Pre-trip information – Modal changes and multimodal information <4><5>

(2) On-trip Information

- On-trip information – Roadside <1>
- On-trip information – In-vehicle signing
- On-trip information – Public transport vehicle <4>
- On-trip information – Parking information <5>
- On-trip information – Through mobile devices <1>

(3) Travel Service Information

- Travel service information – In-vehicle
- Travel service information – Personal interactive
- Travel service information – Dedicated location

(4) Route Guidance and Navigation Pre-trip

- Dynamic in-vehicle route guidance and navigation programming/setup
- Integrated multi-modal trip guidance
- Pedestrian of bicycle route guidance

(5) Route Guidance and Navigation On-trip

- Autonomous in-vehicle navigation
- Dynamic in-vehicle route guidance and navigation (based on real-time network information)
- Integrated multi-modal trip guidance

- Pedestrian of bicycle route guidance

(6) Trip Planning Support

- Individual trip planning
- Centralized trip planning

2) Traffic Management and Operation Service Groups

(1) Traffic Management and Control

- Traffic monitoring <1>
- Surface street traffic management <1>
- Freeway traffic management <1>
- Preferential treatment for specific vehicle types (signal priority and pre-emption)
- Reversible lane management
- Traffic information dissemination <1>
- Coordination of surface street and freeway traffic management <1>
- Inter-modal highway junction management <4>
- Parking management <5>
- Work zone traffic management <1>
- Data achieving <1>
- Data warehouse <1>

(2) Transport Related Incident Management

- Incident monitoring and confirmation <1>
- Incident on-site motorist assistance <1>
- Incident on-site traveler assistance <1>
- Incident coordination and clearance <1>
- Hazardous materials monitoring and management

(3) Demand Management

- Variable road pricing <6>
- Access management <6>
- High-occupancy lane management
- Air quality-based road transport management

(4) Transport Infrastructure Maintenance Management

- Roadway construction and maintenance management
- Winter maintenance
- Pavement management
- Automated road management
- Work zone safety management

(5) Policing/Enforcement Traffic Regulations

3) Vehicle Service Groups

(1) Transport-related Vision Enhancement

- In-vehicle driver vision management

(2) Automated Vehicle Operation

- Automated highway operation
- Automated low-speed maneuvering
- Precision docking for public transport vehicles
- Automated cruise control

(3) Collision Avoidance

- Longitudinal collision avoidance
- Lateral collision avoidance
- Intersection collision avoidance

(4) Safety Readiness

- Vehicle internal systems monitoring
- Vehicle external conditions monitoring

(5) Pre-crash Restraint Deployment

- Pre-crash restraint deployment

4) Freight Transport Service Groups

(1) Commercial Vehicle Pre-clearance

- Weigh in-motion <3>
- Non-stop pre-clearance <3>
- Vehicle safety records monitoring

(2) Commercial Vehicle Administrative Processes

- Automated credential filing
- Automated commercial vehicle administration
- Automated border crossing

(3) Automated Roadside Safety Inspection

- Remote access to commercial vehicle safety data

(4) Commercial Vehicle On-board Safety Monitoring

- Commercial vehicle internal systems monitoring
- Commercial vehicle driver alertness monitoring

(5) Freight Transport Fleet Management

- Commercial vehicle fleet tracking <3>
- Commercial vehicle fleet dispatching
- Freight container tracking

(6) Inter-modal Information Management

- Vehicle and container arrival information exchange (users are fleet and inter-modal carriers and nodes)
- Customer freight information access (users are customers and shippers)

(7) Management and Control of Inter-modal Centers

- Inter-modal center facility management
- Inter-modal vehicle and container control

(8) Management of Dangerous Freight

- Dangerous goods movement data sharing
- Dangerous goods movement data registry
- Dangerous goods movement fleet coordination
- Dangerous goods movement police/safety coordination

5) Public Transport Service Groups

(1) Public Transport Management

- Public transport vehicle internal systems monitoring
- Public transport vehicle fleet tracking <4>
- Public transport scheduling services
- Public transport service dispatch
- Public transport service planning

(2) Demand Responsive and Sheared Transport

- Para-transit fleet dispatch
- Dynamic ridesharing

6) Emergency Service Groups

(1) Transport Related Emergency Notification and Personal Security

- Automated 911 and mayday dispatch

(2) After Theft Vehicle Recovery

- Dynamic ridesharing

(3) Emergency Vehicle Management

- Emergency vehicle fleet tracking
- Emergency vehicle – traffic management coordination

(4) Hazardous Materials and Incident Notification

- Hazmat vehicle tracking <3>
- Automated hazmat 911/mayday notification
- Hazmat pre-clearance services <3>

7) Transport Related Electronic Payment Service Groups

(1) Transport Related Electronic Financial Transactions

- Electronic transit fare collection <2>
- Electronic toll collection <2>
- Electronic parking payment <5>
- Electronic services payment (e.g. traveler information, reservations) <5>
- Electronic distance-based road user fee payment services

(2) Integration of Transport Related Electronic Payment Services

- Integration of multi-jurisdictional electronic payment systems <2>
- Integration of regional multi-modal payment systems <5>

8) Road Transport Related Personal Safety Groups

(1) Public Travel Security

- Silent alarm
- 911/mayday alert for public transport
- Intrusion detection
- Public transport surveillance <4>

(2) Safety Enhancement for Vulnerable Road Users

- Non-motorized vehicle and pedestrian monitoring systems
- Systems to monitor specialized vehicles

(3) Safety Enhancement for Disabled Road Users

- Intersection monitoring of specialized conveyances (e.g. wheelchairs, carts)
- Driver warnings for specialized conveyances

(4) Safety Provisions for Pedestrians Using Intelligent Junctions and Links

- Signal display advance warning
- Oncoming vehicle advance warning (for non-signalized junction)
- In-vehicle signage and warning systems

9) Weather and Environmental Conditions Monitoring Service Groups

(1) Weather Monitoring

- Road weather information monitoring <1>
- Road weather prediction

(2) Environmental Conditions Monitoring

- Water level/tidal monitoring and prediction
- Seismic monitoring
- Pollution monitoring
- Avalanche, mud slide, fallen rock monitoring

10) Disaster Response Management and Coordination Service Groups

(1) Disaster Data Management

- Disaster and emergency data collection

- Disaster and emergency data sharing

(2) Disaster Response Management

- Disaster response planning for the transport network
- Disaster response implementation

(3) Coordination with emergency Agents

- Disaster response coordination

11) National Security Service Groups

(1) Monitoring and Control of Suspicious Vehicles

- Vehicle hazmat and explosives monitoring
- Vehicle disablement
- Road traffic management
- Identification of suspicious vehicles

(2) Utility or Pipeline Monitoring

- Pipeline and utility hazmat/explosive monitoring
- Emergency notification to key agencies

APPENDIX 4

Benefit Metrics of ITS Proposed in USA

Appendix 4

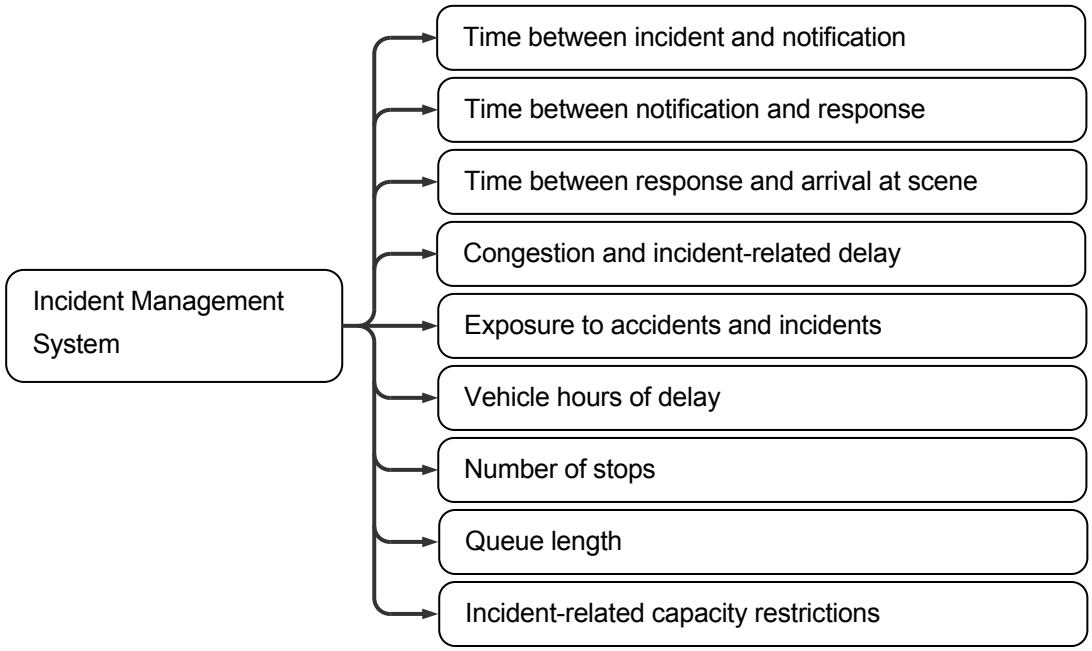
Benefit Metrics of ITS Proposed in USA

The benefit metrics shown in the table below are proposed based on the discussion of the national ITS architecture in USA from many different aspects.

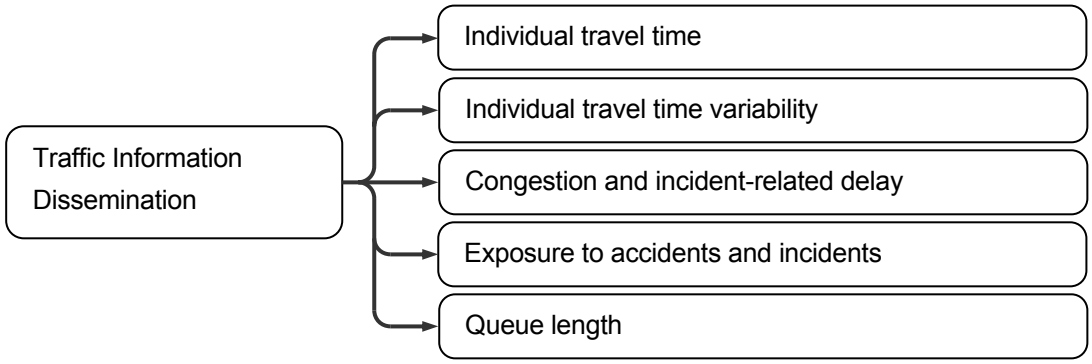
ITS Goals in USA	Benefit Metrics
Increase Transportation System efficiency and Capacity	Traffic flows/Traffic volumes/Number of vehicles
	Lane carrying capacity
	Volume to capacity ratio
	Vehicle hours of delay
	Queue length
	Number of stops
	Incident-related capacity restrictions
	Average vehicle occupancy
	Use of transit and HOV modes
	Inter-modal transfer time
	Infrastructure operating costs
	Vehicle operating costs
Enhance Personal Mobility	Number of trips taken
	Individual travel time
	Individual travel time variability
	Congestion and incident-related delay
	Travel cost
	Vehicle miles traveled
	Number of accidents
	Number of security incidents
	Exposure to accidents and incidents
Improve Safety	Number of incidents
	Number of accidents
	Number of injuries
	Number of fatalities
	Time between incident and notification
	Time between notification and response
	Time between response and arrival at scene
	Time between arrival and clearance
	Medical costs
	Property damage
	Insurance costs
Reduce Energy Consumption and Environmental Costs	NOx emissions
	SOx emissions
	CO emissions
	VOC emissions
	Liters of fuel consumed
	Vehicle fuel efficiency
Increase Economic Productivity	Travel time savings
	Operating cost savings
	Administrative and regulatory cost savings
	Manpower savings
	Vehicle maintenance and depreciation
Create an Environment for an ITS Market	ITS sector jobs
	ITS sector output
	ITS sector exports

For example, the benefit metrics provided by major ITS user services can be shown in the following figures excerpted from the national ITS architecture in USA.

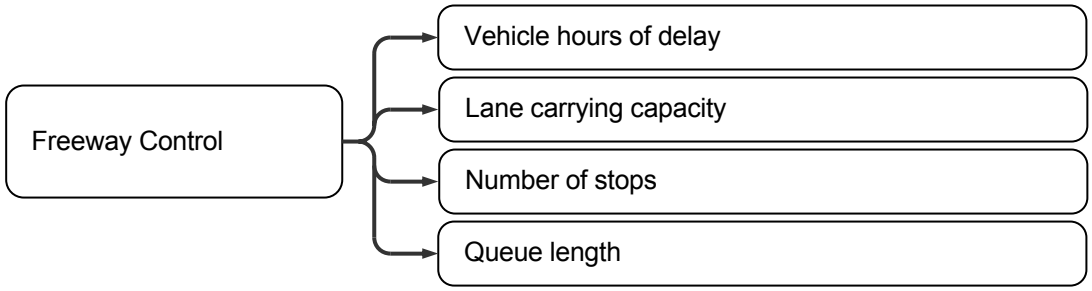
1) Metrics from Incident Management System



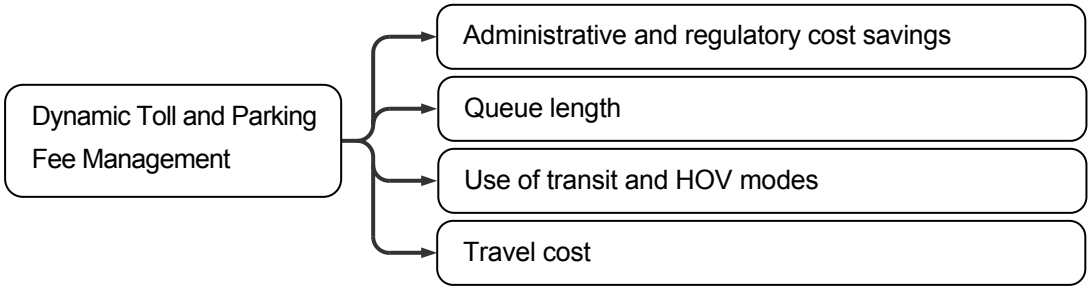
2) Metrics from Traffic Information Dissemination



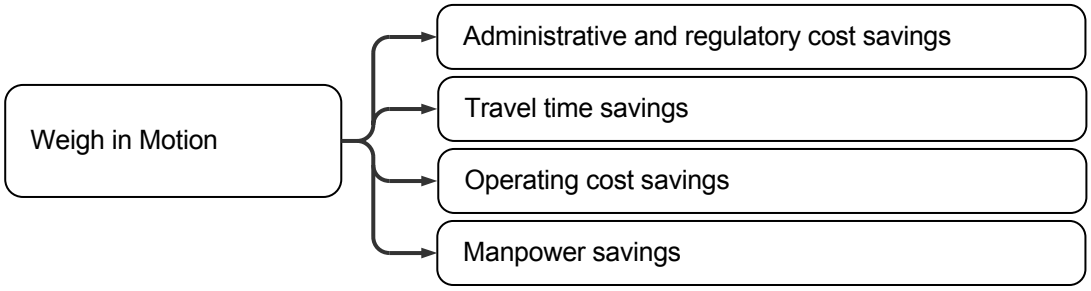
3) Metrics from Freeway Control



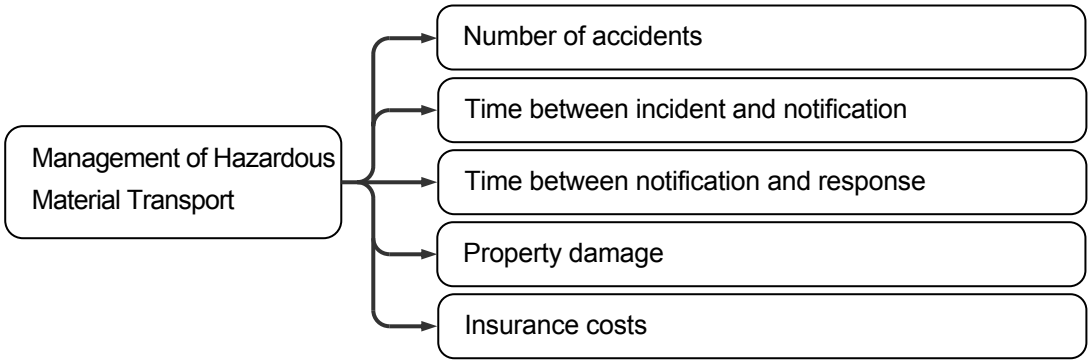
4) Metrics from Dynamic Toll and Parking Fee Management



5) Metrics from Weigh in Motion



6) Metrics from Management of Hazardous Material Transport



APPENDIX 5

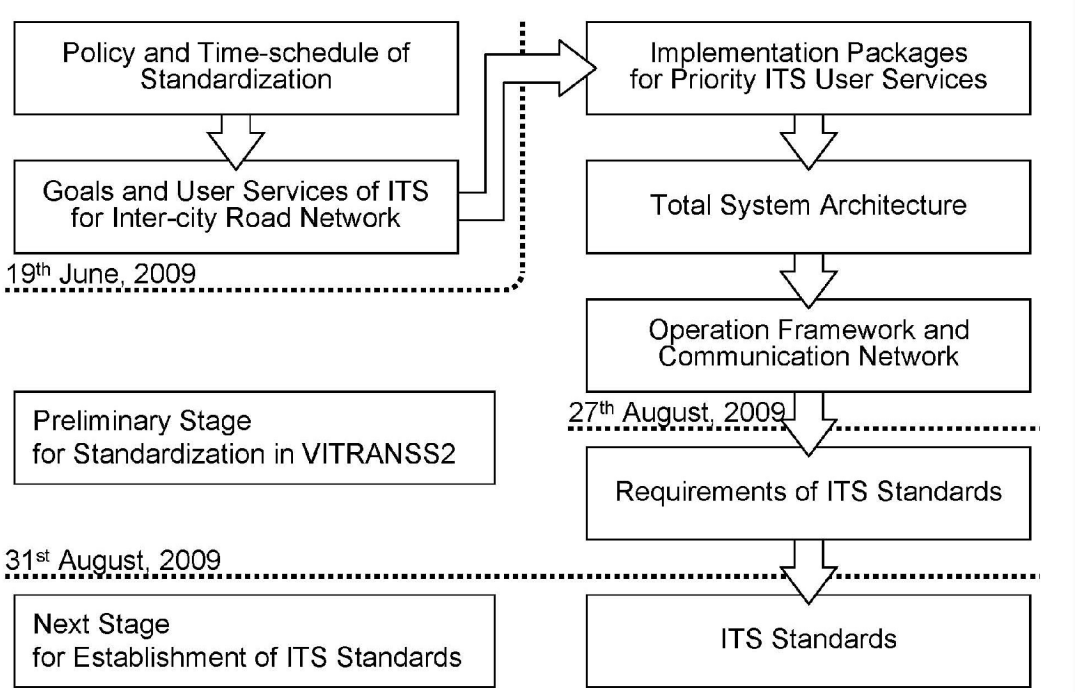
Records of ITS Working Group

Appendix 5

Records of ITS Working Group

The issues in the Master Plan has been discussed in the ITS Working Group and the ITS Workshop held by the following passage.

Figure A5.1 Passage of ITS Working Group and ITS Workshop



19th June	● Goals and user services of ITS for inter-city road network ● Example of Implementation package ● Total system architecture.
1st July	● Implementation packages for traffic information & control ● Total system architecture.
14th July	● Implementation packages for nonstop toll collection ● Total system architecture ● Operation framework and Communication network.
5th August	● Implementation packages for heavy truck control ● Total system architecture ● Operation framework and Communication network.
27th August	● Operation framework and Communication network ● Recommendation of "Requirements of ITS Standards".
31st August	● ITS Workshop.

Figure A5.2 Scenes in Meeting of 1st ITS Working Group

The materials: PDF files of the Vietnamese slides shown in the ITS Working Group and the ITS Workshop are to be submitted with the Master Plan Report.