



Introduction of Japanese SMARTWAY 2007

May 2007





1

1) Test locations

• Test locations are selected to realize an optimal system to provide safety measures and information, etc., in view of the characteristics of each location.





2) On-board units

- It is important to also provide audio information regarding safety, etc. to vehicles which are not equipped with car navigation systems (mostly trucks) in order to improve safety.
- Two types are used: Independent ITS on-board unit, which provide information as audio only; and ITS on-board unit integrated with car navigation systems, which are connected to car navigation systems to provide information in both audio and visual form.





3) Features of services

• Smartway will provide services with the following features, based on the results of public-private joint research.

[1] Timely services

Safety information will be provided in a timely manner, based on road traffic conditions on the route where the vehicle is traveling.

[2] Services that are reliable and understandable

Drivers will be provided with prompt, reliable information regarding safety and so on by means of 5.8 GHz DSRC, which supports highly reliable communications for the instantaneous supply of large volumes of information.

[3] Services that are easily noticed by drivers

Audio and visual information will be provided using on-board units, which have a higher driver recognition rate than roadside signs and the like.





4) Testing methods

• Beginning on May 14, 2007, driving tests using a total of 60 vehicles will be performed on the Tokyo Metropolitan Expressways, with cooperation from private businesses.

Scale of testing

26 participating companies as of March 31, 2007

(9 carmakers and 17 manufacturers of on-board units and appliances)

Testing to begin on May 14, 2007 Total of 60 vehicles to be used in testing

Test courses

Route for providing information on obstacles ahead:

Hatsudai on Route 4 (Shinjuku Line) → Kasumigaseki (inbound) on the Inner Loop Line

Route for providing information on conditions ahead:

Takaido on Route 4 (Shinjuku Line)→ Kandabashi (outbound) on the Inner Loop Line→Kasumigaseki (outbound) on the Inner Loop Line

Route for merging assistance:

Kita-Ikebukuro on Route 5 (Ikebukuro Line) → Iidabashi on Route 5 (Ikebukuro Line)

Route for map-linked services:

Takaido on Route 4 (Shinjuku Line)→ Outbound traffic on the Inner Loop Line → Nakadai on Route 5 (Ikebukuro Line)

Nakadai on Route 5 (Ikebukuro Line) → Kasumigaseki (inbound) on the Inner Loop Line

Preparations for testing





4) Testing methods

• Vehicles are driven on separate test courses, depending on the purpose of testing.





5) Study procedures

- Steps are being taken on the Tokyo Metropolitan Expressways toward the full-scale implementation of next-generation road services (Smartway 2007).
- Various types of information will be provided in the tests to verify effectiveness, user acceptance, etc.

<Efficient deployment in collaboration with related government ministries and agencies>



1. Selection of the routes and locations



- The routes in particular need of safety measures have been identified, based on accident rates and accident density.
- The Inner Loop Line, Route 4 (Shinjuku Line), and Route 5 (Ikebukuro Line) of the Tokyo Metropolitan Expressways were selected as the routes requiring countermeasures.

Ranking by accident rate	1	2	3	4	5
Total number of accidents	Yaesu Line	Inner Loop Line	Route 6 (Misato Line)	Route 4 (Shinjuku Line)	Kanagawa Route 5 (Daikoku Line)
Fatal accidents	Yaesu Line	Inner Loop Line	Route 11 (Daiba Line)	Route 2 (Meguro Line)	Route 4 (Shinjuku Line)

Routes with high accident rates (number of accidents per 100 million vehicle-kilometers)

Routes with high density of accident occurrence (number of accidents per kilometer per year)

Ranking by accident density	1	2	3	4	5
Total number of accidents	Inner Loop	Route 4	Route 5	Route 1 (Haneda	Route 11 (Daiba
	Line	(Shinjuku Line)	(Ikebukuro Line)	Line)	Line)
Fatal accidents	Inner Loop	Route 4	Route 6	Route 5	Route 1 (Haneda
	Line	(Shinjuku Line)	(Misato Line)	(Ikebukuro Line)	Line)

Route 4 (Shinjuku Line), Route 5 (Ikebukuro Line),

and the inner loop lines connecting to these routes were selected.

2. Lineup of services



• Providing a variety of next-generation road services, including safety services

Statem	Information supply mode		Durran	Santan anna an	Test lo setions	
System	Audio	Audio + visual	Purpose	System summary	l est locations	
(1) Providing information on obstacles ahead	\checkmark	\checkmark	 (Assisting for safe driving) To reduce rear-end collisions with stopped or slow-moving vehicles beyond a curve with poor visibility. To reduce secondary accidents. 	• Roadside sensors detect stopped vehicles or congestion beyond a curve with poor visibility and warn drivers entering the curve by visual and audio information.	At curves with frequent accidents, including Sangubashi (toward central Tokyo) and Shinjuku (toward central Tokyo).	
(2) Providing information on conditions ahead (audio + visual) 示 坂TN手前 這路 Traffic is congested in the direction of xxx	\rightarrow \checkmark		 (Assisting for safe driving) To reduce rear-end collisions at the beginning of congested areas near tunnels, sags, etc., or with stopped or slow- moving vehicles ahead. (Relieving congestion) Reducing congestion due to accidents, etc. 	• Road conditions ahead are communicated to drivers in visual form to call their attention.	Just before locations where congestion is anticipated. Gaien (toward central Tokyo): visual information just before Akasaka Tunnel. Kandabashi (outbound): visual information for Hakozaki Junction; etc.	
(3) Providing information on conditions ahead (audio only))			Road traffic information on congestion, etc., is supplied in audio form by highway radio.	Just before locations where congestion is anticipated. Eifuku (toward central Tokyo): visual information just before inner-city portion, etc.	
(4) Merging assistance	\checkmark		 (Assisting for safe driving) Reducing accidents due to vehicle contact at merge points. Reducing rear-end collisions. 	• Roadside sensors detect vehicles approaching a merge point. Just before the merge point, drivers are alerted to the presence of merging vehicles by visual and audio information.	At merge points with frequent accidents, including Tanimachi Junction (outbound) and Higashi- Ikebukuro (away from central Tokyo).	

2. Lineup of services



Sustam	Information supply mode		Dumoso	System summery	Test logotions	
System	Audio	Audio + visual	Purpose	System summary	l est locations	
(5) Information provision (IP data link)	\checkmark	\checkmark	 (Improved convenience) Greater convenience. Supplying information in advance for a greater sense of safety and peace of mind. 	• Using 5.8 GHz DSRC, wireless LAN, etc. to provide Internet connectivity to vehicles parked at service areas, parking areas, etc.	Parking areas (Daikoku PA)	
(6) Use of various communications media			 (Improved convenience) Greater convenience. Supplying information in advance for a greater sense of safety and peace of mind. 	 Using various communications media, including public wireless LAN. Studying uses such as simple bus location services in rural areas, based on the results of proving tests. 	Three Tokyo Metropolitan Expressway routes: Route 4 (Shinjuku Line), Inner Loop Line, and Route 5 (Ikebukuro Line)	
(7) Map-linked services to call attention and provide information		\checkmark	 (Assisting for safe driving) Reducing accidents due to excessive speed when entering a curve, such as contact with facilities, rear-end collisions, contact with other vehicles, side rollovers, and complete rollovers. Supplying information in advance for a greater sense of safety and peace of mind at locations with frequent accidents. 	 Calling attention to speed, etc. while driving, based on map databases in car navigation systems, including road curvature data. Providing information on locations with frequent accidents, as well. 	Locations with frequent accidents (providing information through linkage of digital maps and car navigation systems)	
(8) Smart parking			 (Improved convenience) Greater convenience. Providing opportunities to rest for a greater sense of safety and peace of mind. 	• Using ETC user vehicle numbers to provide parking fee payment services based on ETC on-board units.	Kabuto-cho parking facility	
(9) Information provision (electronic signs)			 (Support for safe driving) Providing accurate, understandable information for improved safety. 	 Support for determining one's location at entrance ramps, etc. Providing simple sign information as well. 	Entrance ramps: Takaido (toward central Tokyo) and Hatagaya ramp	



1) Method of evaluation

• Testing will be verified from three perspectives: verifying system functions, verifying system effectiveness based on vehicle behavior, and verifying system effectiveness based on driver opinions.

(1) Verifying system functions

- Determining whether roadside units and on-board units are functioning as required with regard to data collection, processing, and supply functions.
- Determining whether multiple ways of detecting phenomena, having different implementation costs, are capable of adequate detection of phenomena.

(Evaluation indices) Detection rates by sensors and interpretation software, etc.

(2) Verifying system effectiveness based on vehicle behavior

Determining whether drivers adequately follow the expected behavior upon receiving information.
 (Evaluation indices) Presence of sudden braking, abrupt steering, etc.

(3) Verifying system effectiveness based on driver opinions

• Determining whether drivers actually perceive the system's intended effects.

(Evaluation indices) Perceived level of effectiveness, willingness to pay, effectiveness of information supply, desire to continue using the system, etc.

Visual sensor approach



2) Summary and items for verification [1]-1 Providing information on obstacles ahead

• Roadside sensors detect stopped vehicles or congestion beyond a curve with poor visibility and warn drivers entering the curve by visual and audio information.

Information is provided at 2.5 GHz (visual only), 5.8 GHz DSRC (visual + audio), or in audio form alone.

• We will verify whether the system adequately detects the phenomena, and consider approaches with lower implementation costs.

Audio: Beep! Congestion ahead.

Audio: Been! Congestion ahead.

Drive Carefully!

Audio + visual

Audio only

Drive Carefully!

Information supply by

Emergent event

Analysis of traffic

low monitoring

information

DSRC

Roadside processing device

· Providing emergent

event informati

 Storing vehicle behavior data

(Conceptual illustration of the system)

FILL

Sensor

(Anticipated benefits)

- Fewer rear-end collisions beyond curves with poor visibility
- Lower frequency of near-misses (rapid deceleration)
- Lower speeds when entering the curve

(Test locations (tentative))

At curves with frequent accidents: Sangubashi (toward central Tokyo), Shinjuku (toward central Tokyo), and Akasaka Tunnel (toward central Tokyo).

Vehicle behavior

onitored





2) Summary and items for verification [2] -1 Providing information on conditions ahead (audio + visual)

- Drivers are provided with visual information on road conditions ahead in order to support their selection of routes.
- 5.8 GHz DSRC will be used to provide static camera images of tunnels and other locations with frequent congestion. In addition, the content of nearby information signs will be provided in audio form.

(Conceptual illustration of the system)



(Test locations(tentative))

Just before locations where congestion is anticipated. Gaien (toward central Tokyo): visual information just before Akasaka Tunnel; Kandabashi (outbound): visual information for Hakozaki Junction; etc.

(Anticipated benefits)

- Providing visual information on road conditions ahead
- Improved peace of mind for drivers; improved safety margin when driving; support for route selection by drivers.
- Providing audio information on road conditions ahead
- → Improved recognition rate when combined with visual information; improved peace of mind for drivers.





2) Summary and items for verification[3] -1 Providing information on conditions ahead (audio only)

- Road traffic information provided by highway radio is supplied according to the driver's location and direction of travel, in order to enhance the driver's peace of mind.
- Specifically, road traffic information including congestion is provided in audio form using 5.8 GHz DSRC.

(Conceptual illustration of the system)



(Anticipated benefits)

- Providing audio information on road conditions ahead
- → Improved peace of mind for drivers and improved safety margin when driving.

Test locations (tentative)

Just before locations where congestion is anticipated, including Eifuku (toward central Tokyo).





2) Summary and items for verification[4] -1 Merging assistance

- To prevent impact accidents at merge points, vehicles approaching a merge point are detected from the roadside; and just before the merge point, drivers are provided with understandable information on the presence of other merging vehicles.
- 5.8 GHz DSRC is used to send warnings either in both audio and visual form, or in audio form only.
- Initially, only vehicles on the main route will receive information. Later, merging vehicles will also receive information. This will then be expanded to include information that will support cooperation between vehicles on both the main route and the merging lane.

(Conceptual illustration of the system)



(Test locations (tentative))

Merge points with frequent accidents: Tanimachi Junction (outbound) and Higashi-Ikebukuro (away from central Tokyo).



(Anticipated benefits)

- Reduced number of vehicle contact accidents at merge points with poor mutual visibility.
- Reduced frequency of near-misses (unusually close approaches and sudden lane changes)
- Reduced sense of anxiety at merge points



2) Summary and items for verification[5] Information provision (IP data link)

- To improve information convenience for users at service areas, parking areas, and so on, parked vehicles will be provided with Internet connectivity using 5.8 GHz DSRC and wireless LAN.
- The home page will provide road traffic information, weather information, store information, and other information on the surrounding area.
- Store information and the like will be provided in audio form at the entrance to the service area or parking area.
- The effectiveness of this supply of information in improving driver convenience will be verified.

(Conceptual illustration of the system)



(Anticipated benefits)

• Improved user satisfaction



(Test locations (tentative))	(Items for veri	fication)		
Parking areas (Daikoku PA)	Verification objective	Items for verification	Evaluation indices	Verification method
Edit View Co Bookmarks Iods Help Edit View Co Bookmarks Iods Help 	Driver acceptance	• Driver satisfaction with the supply of information	 Level of perceived effectiveness Willingness to pay in relation to perceived benefits Effectiveness of information provision Desire to use the service in the 	Questionnaire survey of drivers



2) Summary and items for verification[6] Use of various communications media

- The usability of various communications media, including public wireless LAN, will be confirmed.
- We will study uses such as simple bus location services that could be deployed in rural areas, based on the results of proving tests.

(Conceptual illustration of the system)



(Test locations (tentative))

Three Tokyo Metropolitan Expressway routes: Route 4 (Shinjuku Line), Inner Loop Line, and Route 5 (Ikebukuro Line)

(Items for verification)

Verification objective	Items for verification	Evaluation indices	Verification method
Verification of communicatio ns media	Comparison of connection capabilities	 Communications speed Communications error rate Rate of erroneous data transmission 	 Connection capability Packet transmission capability



2) Summary and items for verification[7] Map-linked services to call attention and provide information

- Car navigation systems will be used to provide information to support safe driving over a broad area, including locations with relatively low accident densities.
- Drivers will be alerted according to their speed of travel, etc. when entering a curve, based on map databases in car navigation systems, including road curvature and gradient data; and information will be provided on locations with frequent accidents.
- The effectiveness of information provision to improve driver safety will be verified.
- We will confirm the absence of hazardous behavior such as sudden braking and abrupt steering.

(Conceptual illustration of the system)



(Test locations (tentative))

kasaka S-Curve and Benkeibori Curve
rom Itabashi Hon-cho Curve to Takebashi
inction
itanomaru Tunnel and Sanbancho Curve
Total: 11 locations

(Items for verification)

Items for verification		Summary	Verification method
Verifying system functions	Timing of information supply and vehicle detection	We will check whether the differences and scattering between the location of information output and the subject location, and the time and distance from service engagement to information output, are within the acceptable limits.	Based on the on-board unit data (time of information supply)
	Appropriateness of duplicated data processing in information supply	We will use on-board unit data to check the information output sequence and check for duplication, and we will verify the feasibility of logical design of output status and level of priority with other information.	Based on the on-board unit data (time of information supply)
Verifying system effectiveness based on vehicle behavior	Speed when entering the location in question, rapid deceleration, and sudden lane changes	We will verify changes due to use or non-use of the service, based on records of speed and acceleration from service engagement to the close of service.	Based on the on-board unit data (time, coordinates, speed, acceleration, etc.)
	Sudden braking and abrupt steering	We will check for sudden braking and abrupt steering, based on acceleration data just after drivers receive information.	
Verifying system effectiveness based	Effectiveness of information supply	The results of a questionnaire survey of drivers will be analyzed.	Questionnaire survey of drivers
on ariver opinions	Tolerance for bothersome or intrusive information supply		



2) Summary and items for verification[8] Smart parking (virtual parking areas)

- There are few parking areas on the Tokyo Metropolitan Expressways, and they are small in scale. There is a low level of service compared to users' needs for relieving the stress of driving and taking restroom breaks during congested periods.
- To resolve this problem, parking area services based on ETC user numbers will be provided to vehicles equipped with ETC on-board units.
- It is anticipated that these smart parking areas will be used as rest areas on the Tokyo Metropolitan Expressway main line. We are studying the possibility of providing users of these parking areas with a discount on main line tolls.
- The effectiveness of this service in improving driver convenience will be verified.

(Conceptual illustration of the system)



(Test locations (tentative))

Kabuto-cho parking facility



2) Summary and items for verification[9] Information provision (electronic signs)

- In order to provide support for determining one's location, electronic signs will be installed at entrance ramps and other places where car navigation systems can easily mistake the vehicle's position.
- Simple sign information will also be provided.
- The effectiveness of this supply of information in improving driver safety will be verified.

(Conceptual illustration of the system)



(Test locations (tentative))

Takaido (toward central Tokyo) and Hatagaya ramp

14/2 17



Source: Metropolitan Expressway Co., Ltd.

Schedule (tentative)



- Preparations for testing are underway in cooperation with expressway companies, private businesses, etc.
- Testing will begin on May 14, 2007.
- We will pursue system coordination with ordinary roads, in collaboration with the relevant government ministries and agencies.



Smartway 2007 Demo



• Smartway 2007 Demo will be held from October 14 to October 17, 2007 to showcase Japan's most advanced ITS services for a wide range of observers from Japan and overseas.

1. Summary

We are planning to hold joint public-private events in October 2007, including trial rides and exhibits, to demonstrate Japan's most advanced ITS services on the Tokyo Metropolitan Expressways for a wide range of observers from Japan and overseas.

2. Schedule

Dates: From October 14 to October 17, 2007 (tentative) Place: Tokyo International Forum

3. Events

Trial rides, exhibits, symposia, etc.