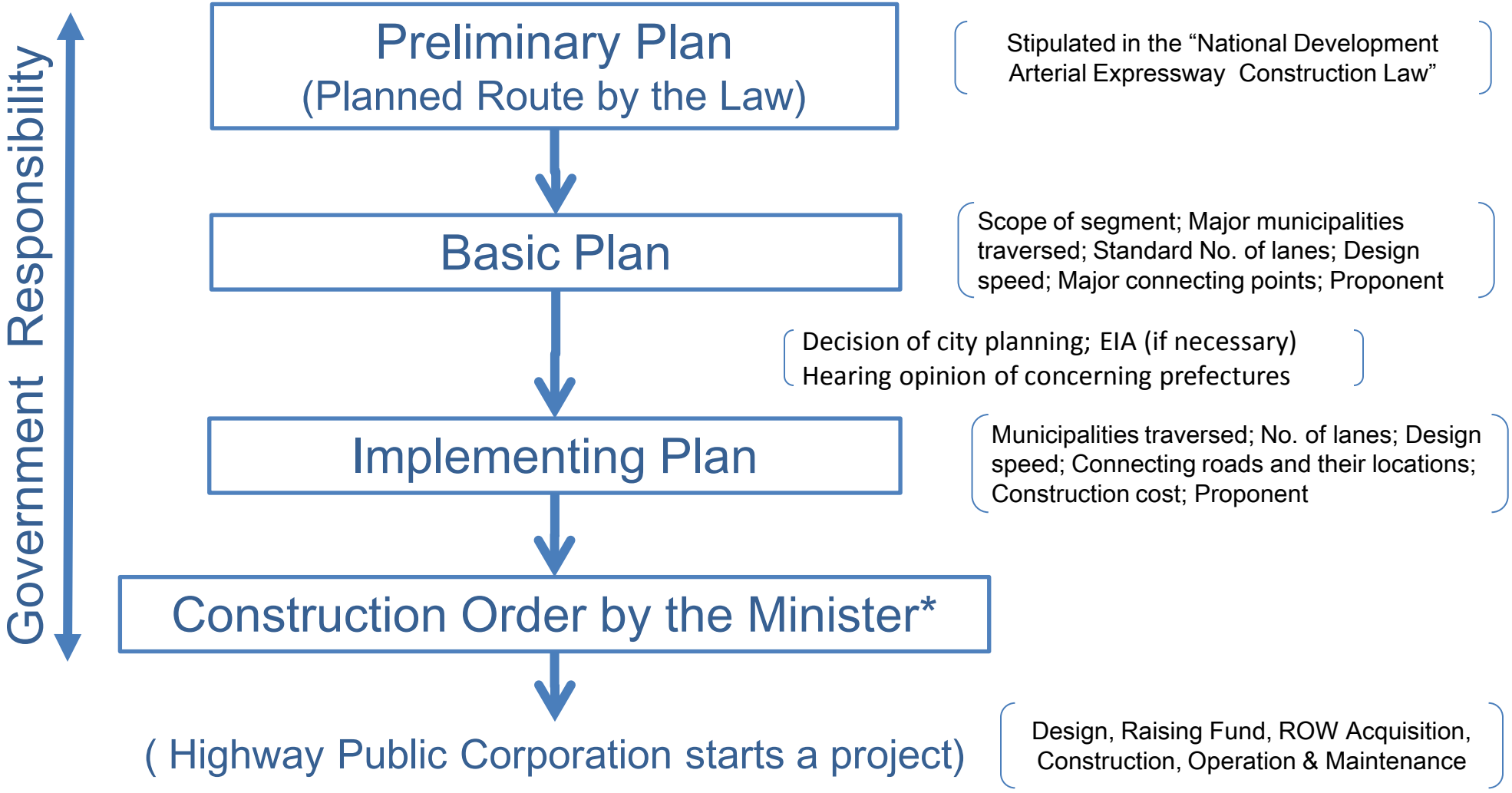
Expressways in Japan

Topics of the Presentation

1. Planning & Development of Expressways in Japan
   - Strong Government Commitment in Planning Stage
2. Funding for Expressway Development in Japan
   - Toll Road & Highway Public Corporations
   - Government Supports
   - Privatization of Highway Public Corporations in 2005
3. Korea and China Cases
   - Toll Road Scheme under BTO&PPP
4. Highway Design Standard
5. Operation & Maintenance
6. Technologies

Procedures of Planning and Developing Expressways
(Prior to the Privatization in 2005)

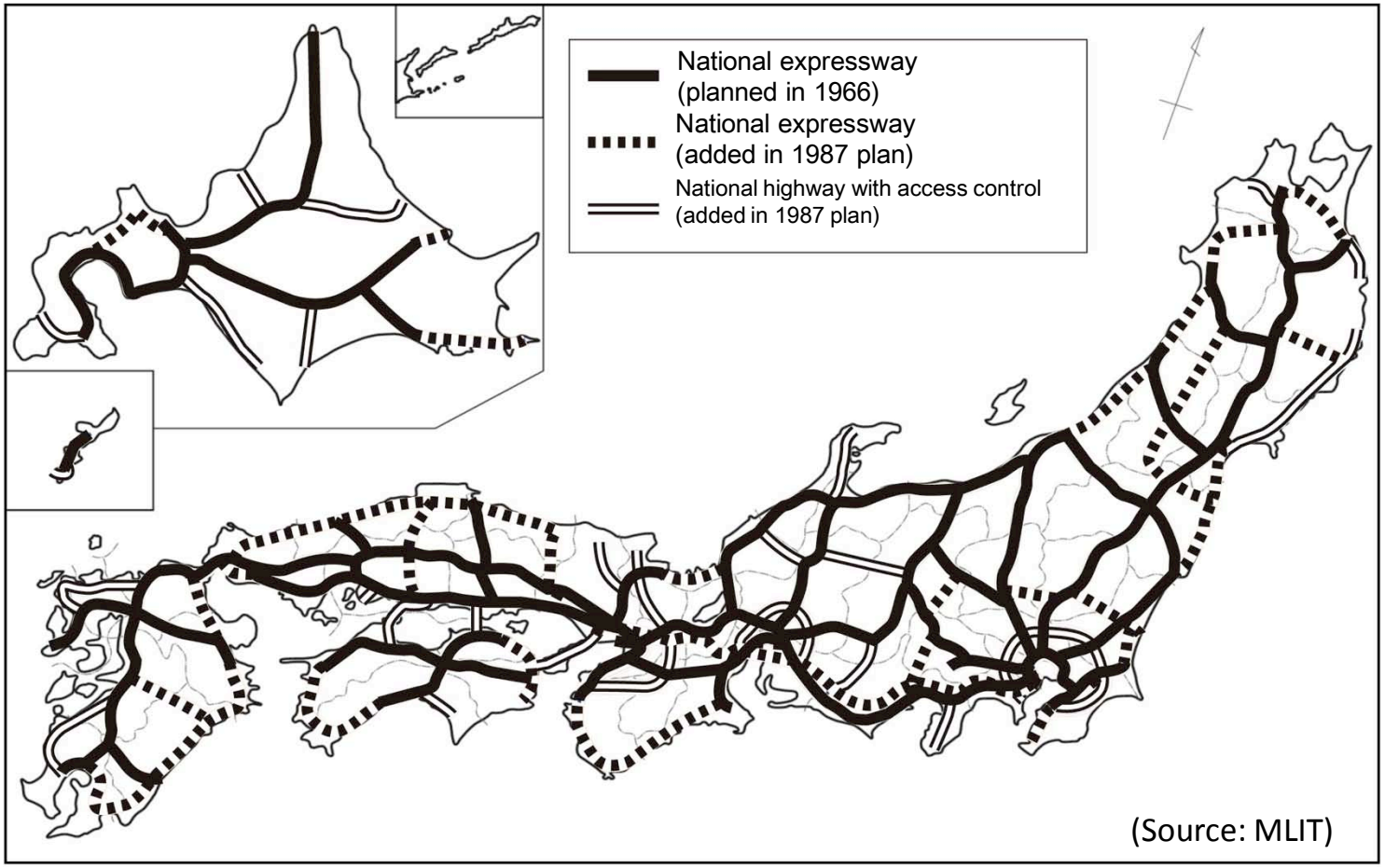


*Since the Privatization in 2005, an Expressway Company has been supposed to commence an expressway project after the Minister of MLIT approves a Plan of Business Activities submitted by the Company.

Current Arterial High-standard Highway Network Plan

The Current Arterial High-standard Highway Network Plan was formulated in 1987, where a total of 14,000km of arterial high-standard highway network was to be constructed including 2,480km of access-controlled national highways.

■ Arterial high-standard highway network planned originally in 1966 and added in 1987



Arterial High-standard Highway Functions and Objectives

Functions of Arterial High-standard Highway (6 requirements)

(1) **Connecting major regional cities effectively**

(2) **Connecting regions circularly neighboring metropolitan areas**

(3) **Connecting major airports/seaports to Arterial High-standard Highways**

(4) **Ensuring the national minimum standards of express traffic service**

Reaching any town/rural area in the nation within an hour and contributing to reducing disparities in access to expressways

(5) **Improving the reliability of the expressway system in the event of a disaster by providing alternative routes**

(6) **Facilitating traffic in the areas that constantly experience heavy traffic congestion in existing Arterial High-standard Highways**

Note: The 1987 Road Council Report on "road requirements for arterial high-standard highway"

Arterial High-standard Highway Network 14,000km

① Expressway network accessible from any town/rural area in the nation within an hour

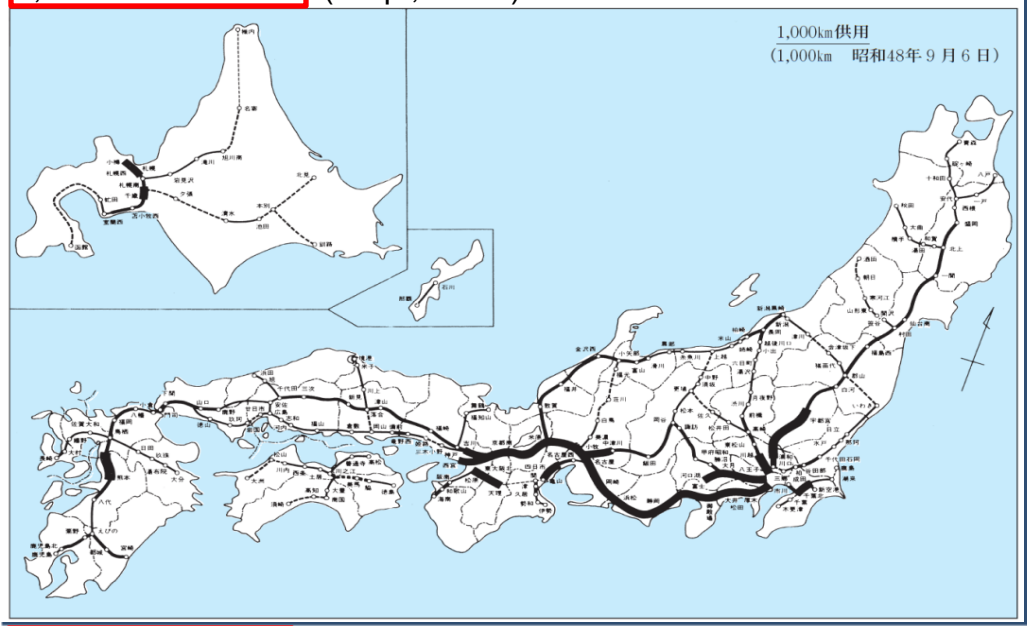
② A 30-miniute travel time to most of the major air/sea ports

③ Connecting to cities with populations of 100,000

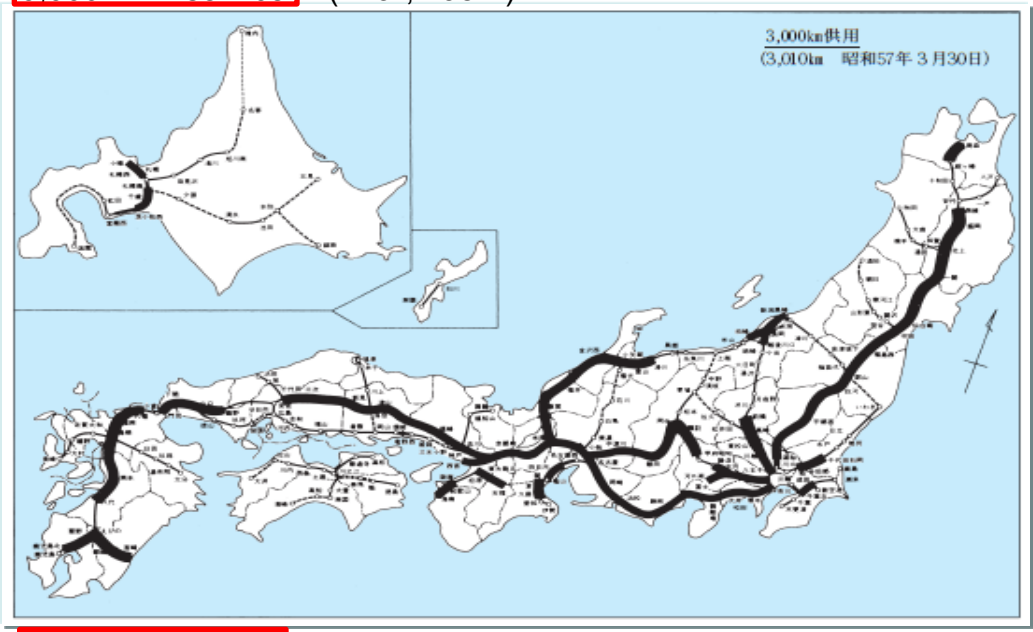
(Source: MLIT)

National Expressway Network Development

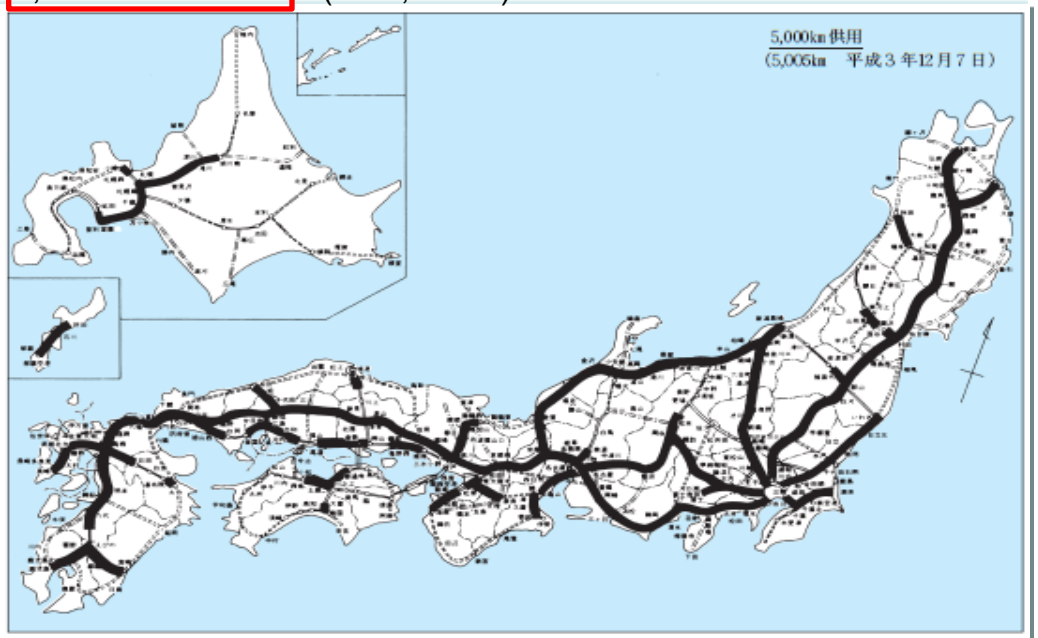
1,000km in service (Sept, 1973)



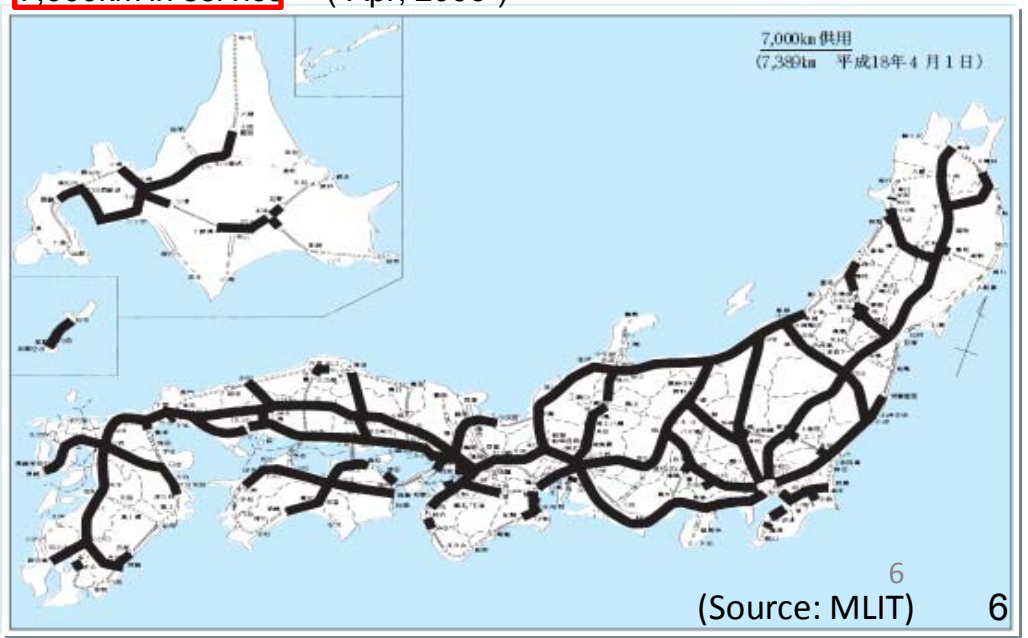
3,000km in service (Mar, 1982)



5,000km in service (Dec, 1991)



7,000km in service (Apr, 2006)



(Source: MLIT)

6

Arterial High-standard Highway Network Development: Targets and Achievement

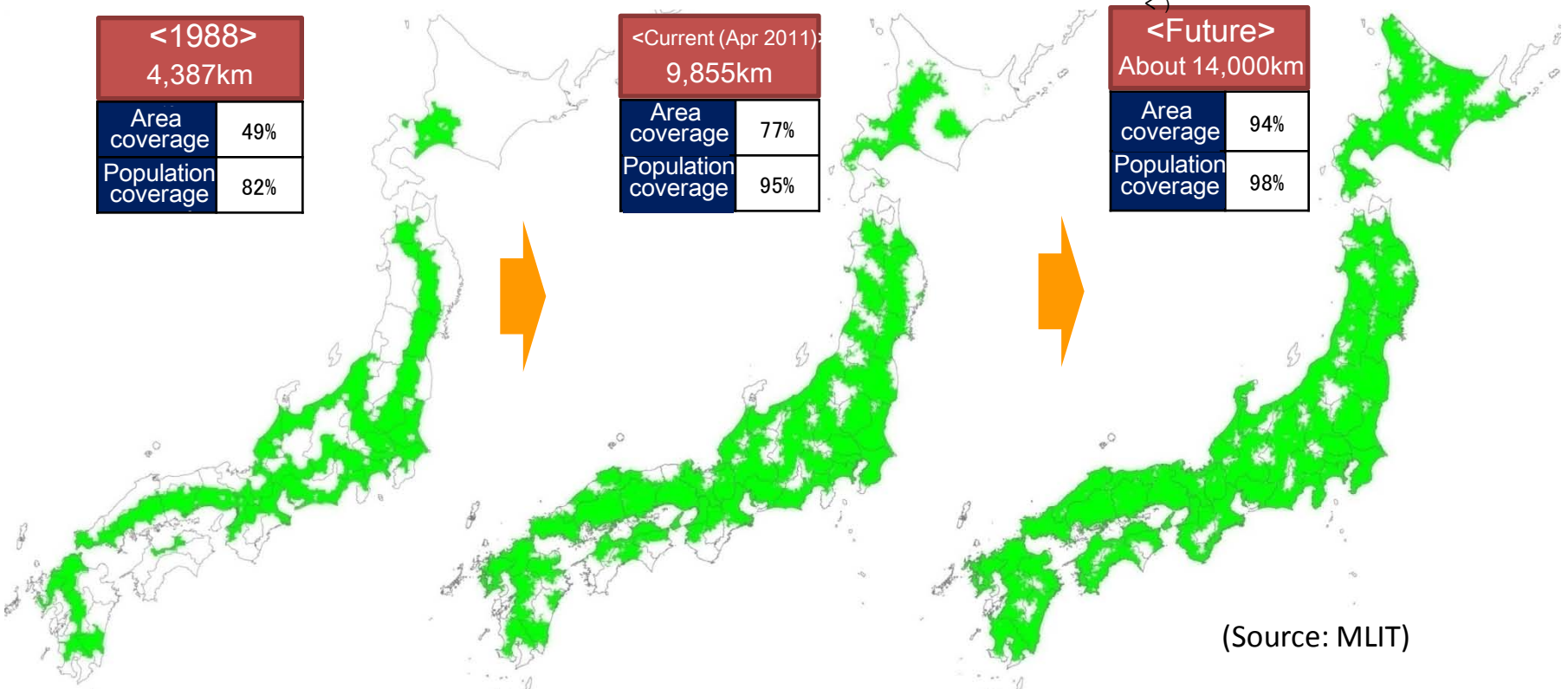
-We achieved some progress toward completing the network that is accessible from any town/rural area in the nation within about 1 hour and accessible to major airports/ports within about 30 minutes.

Target of Arterial High-standard Highway Network Plan		End of FY1987*	Current (Apr. 2011)	Achievement rate
Length of Arterial High-standard Highway in service		4,387km (31%)	9,855km (70%)	14,000km (100%)
Accessible from any city/rural area in the nation within about 1 hour	Pop coverage	82%	95%	98%
	Area coverage	49%	77%	94%
Accessible to major airports/ports** within about 30 min.		79／171 (46%)	117／163 (72%)	165／171 (96%)

* Fiscal Year in Japan ends Mar 31.

** Airports that accommodate jet airplanes
Ports considered significant (based on the plan) excluding isolated islands

<Areas accessible to Arterial High-standard Highway Network within 1 hour>



(Source: MLIT)

International Comparison of Service Levels of High-standard Highway

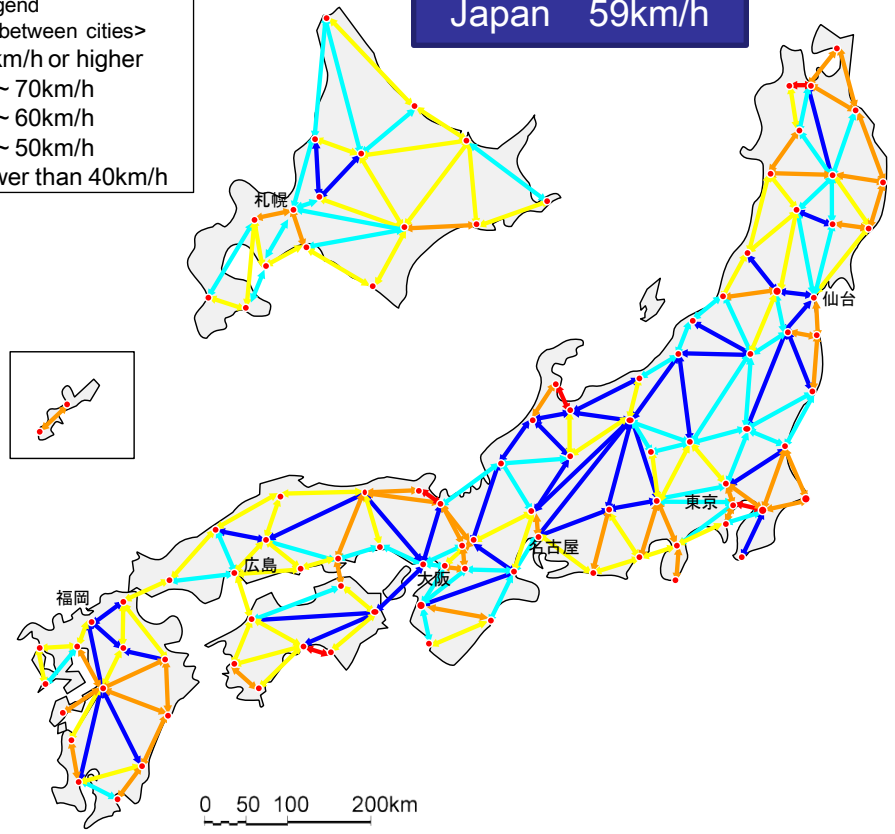
Japanese Arterial High-standard Highway Network still has weak points on missing links and heavily congested urban area.

Travel speed between cities (Mobility between Cities) :
the shortest distance divided by the shortest journey time

- The shortest distance represents the shortest distance of the route between cities.
- The shortest journey time represents the least journey time of the route between cities

Legend
<travel speed between cities>
- 70km/h or higher
- 60 ~ 70km/h
- 50 ~ 60km/h
- 40 ~ 50km/h
- Lower than 40km/h

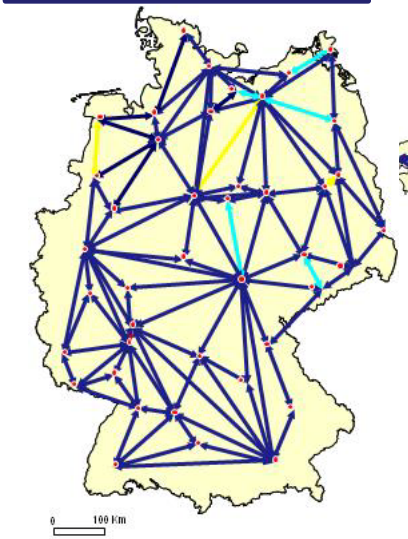
Japan 59km/h



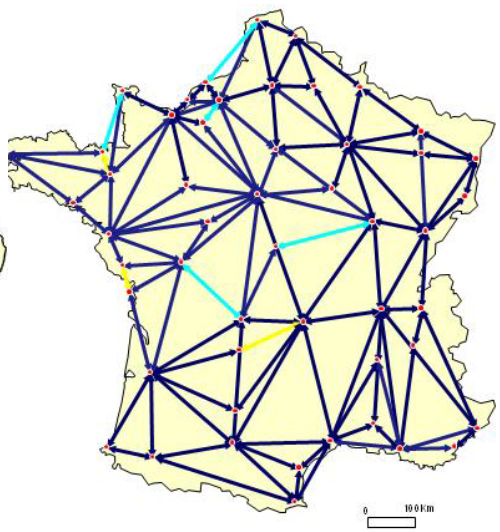
<Travel speed between cities in Japan (based on probe data)>

(Source: MLIT)

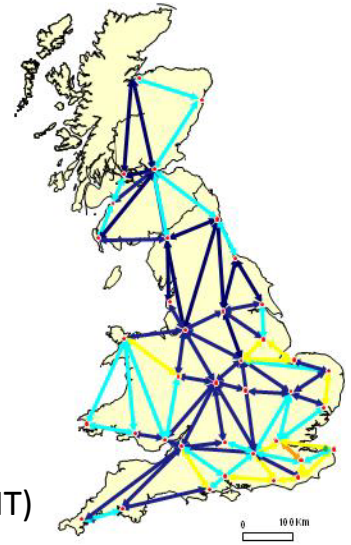
Germany 90km/h



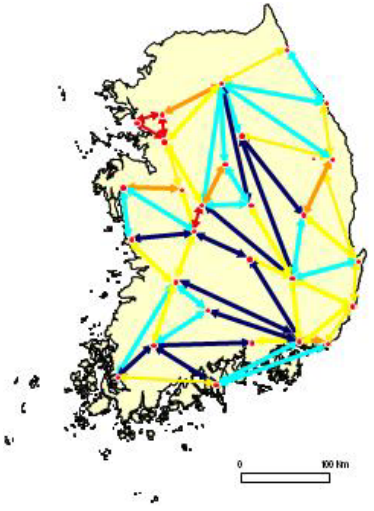
France 88km/h



UK 72km/h

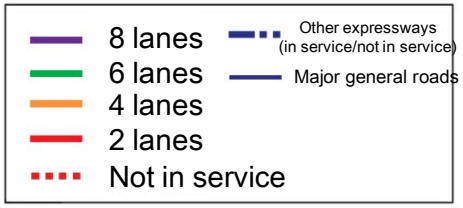


Korea 60km/h

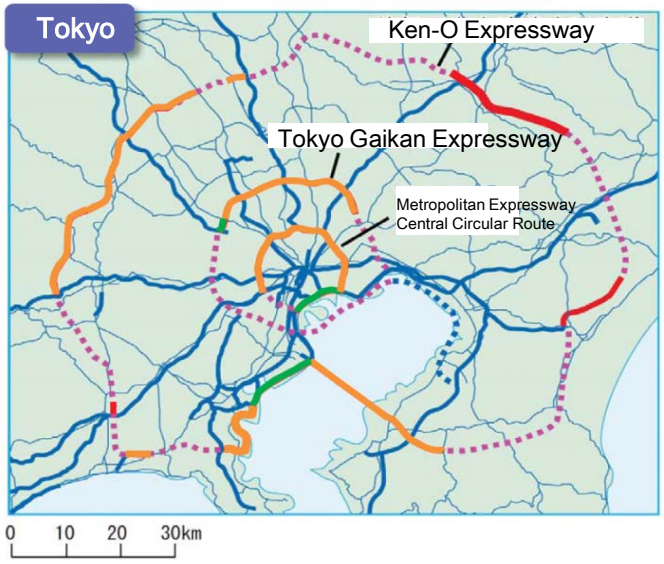


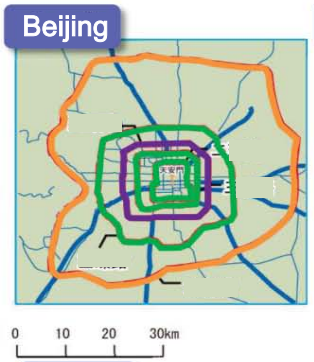
International Comparison of Ring Road Development of Capital Regions

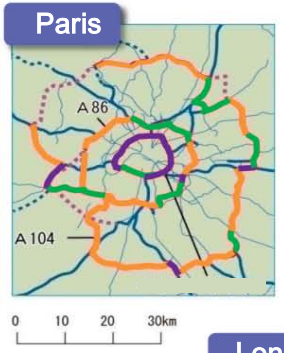
-The ring road system in the Tokyo Metropolitan Area is 47% completed. The area suffers from delay in progress of access controlled ring road. Major cities in other countries have multi-laned ring roads.

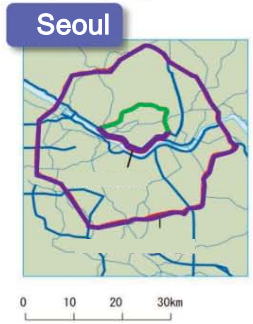


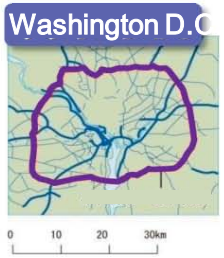
City	Planned length	Opened length	Complete rate	Note
Tokyo	525km	245km	47%	As of Apr 30, 2010
Beijing	433km	433km	100%	Completed on Sep 12, 2009
Seoul	168km	168km	100%	Completed on Dec 28, 2007
Paris	313km	267km	85%	As of Jul, 2009
Washington, D.C.	103km	103km	100%	Completed in 1998
London	188km	188km	100%	Completed in 1986
Berlin	223km	217km	97%	As of Jan, 2009

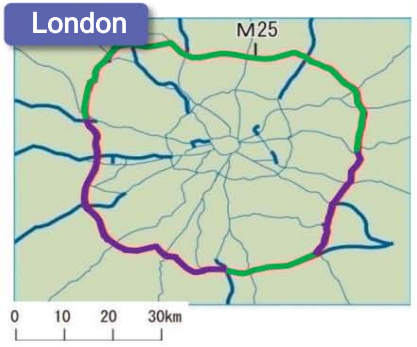












(Source: MLIT)

Introduction of Toll Road System in Japan

In response to a rapid increase in traffic demand after World War II, immediate road developments needed financial resources to add to the general revenue; namely:

① Dedicated Fund for Road Development (source: gasoline tax etc.)

② Toll Road System

1 9 5 2 , the Law Concerning Special Measures for Highway Construction was enacted

→ A toll road system was introduced targeting public roads designated by the Road Law.

(Project proponent : National, prefectural or municipal government as a road administrator)

To expand the current toll road system as a measure of immediate development of roads across the country, an organization like the JHPC needs to be established so that private funds will be widely introduced and comprehensive and efficient operation will be carried out. (Road Council's recommendation, 1955)

1 9 5 6 , Full-fledged revision of the Law Concerning Special Measures for Highway Construction

Act on Japan Highway Public Corporation was enacted.

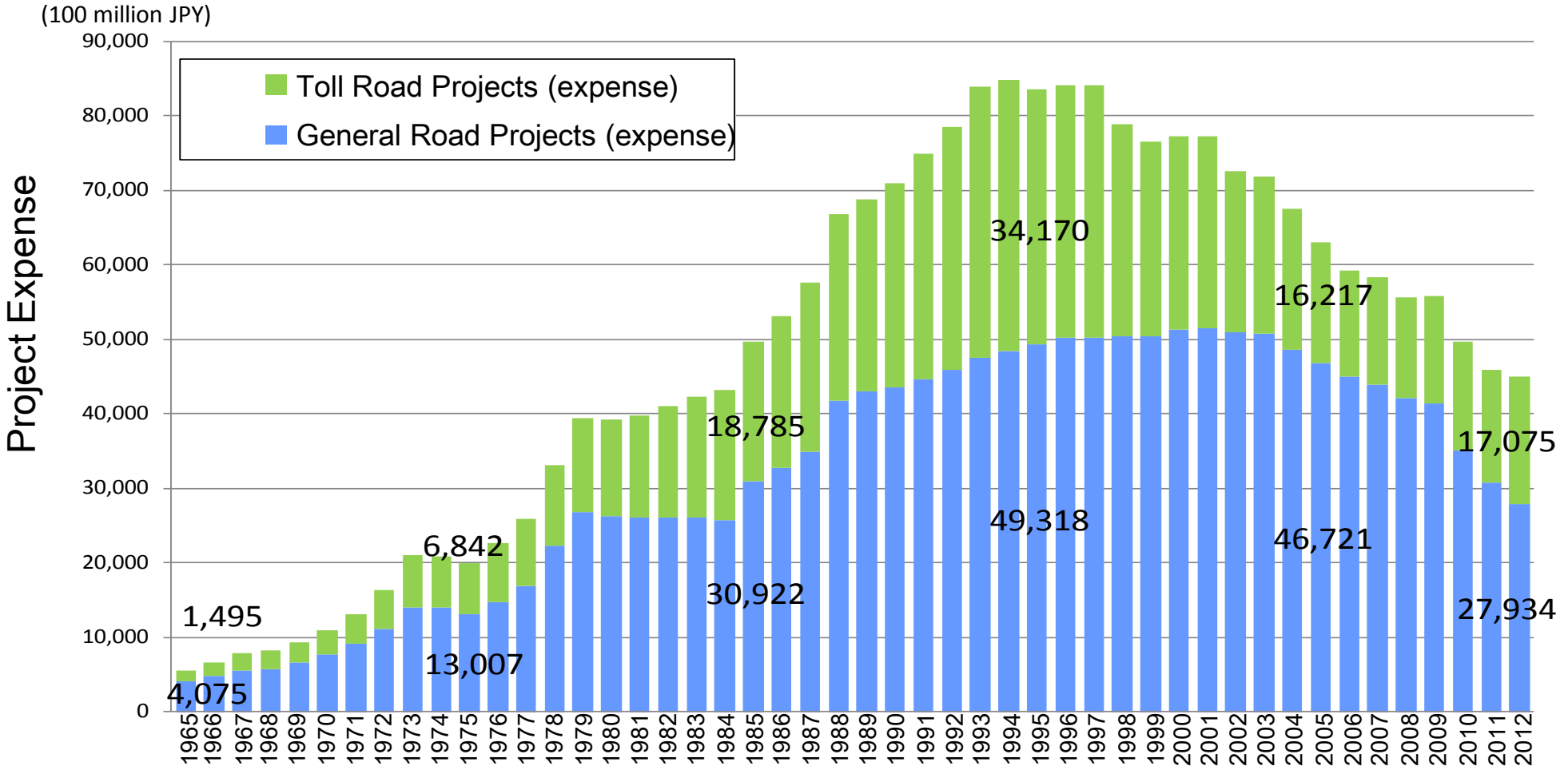
1 9 5 9 , Act on the Metropolitan Expressway Public Corporation was enacted.

1 9 6 2 , Act on the Hanshin Expressway Public Corporation was enacted.

1 9 7 0 , Act on the Honsyu-Shikoku Bridge Authority was enacted.

Composition of the Government Related Road Projects (General Road and Toll Road)

➢30-40% of the central government related road investment have been done as toll road projects.



Note: -Values after 2008 include Temporal Subsidy for Local Road Development.
-Values after 2009 include Subsidy for Vital Local Communities and Subsidy for Local Infrastructure Development
Subsidy for Local Infrastructure Development is an estimated expense for road development from total MLIT projects.
-Values do not include reconstruction work or disaster prevention projects.

(Source: MLIT)

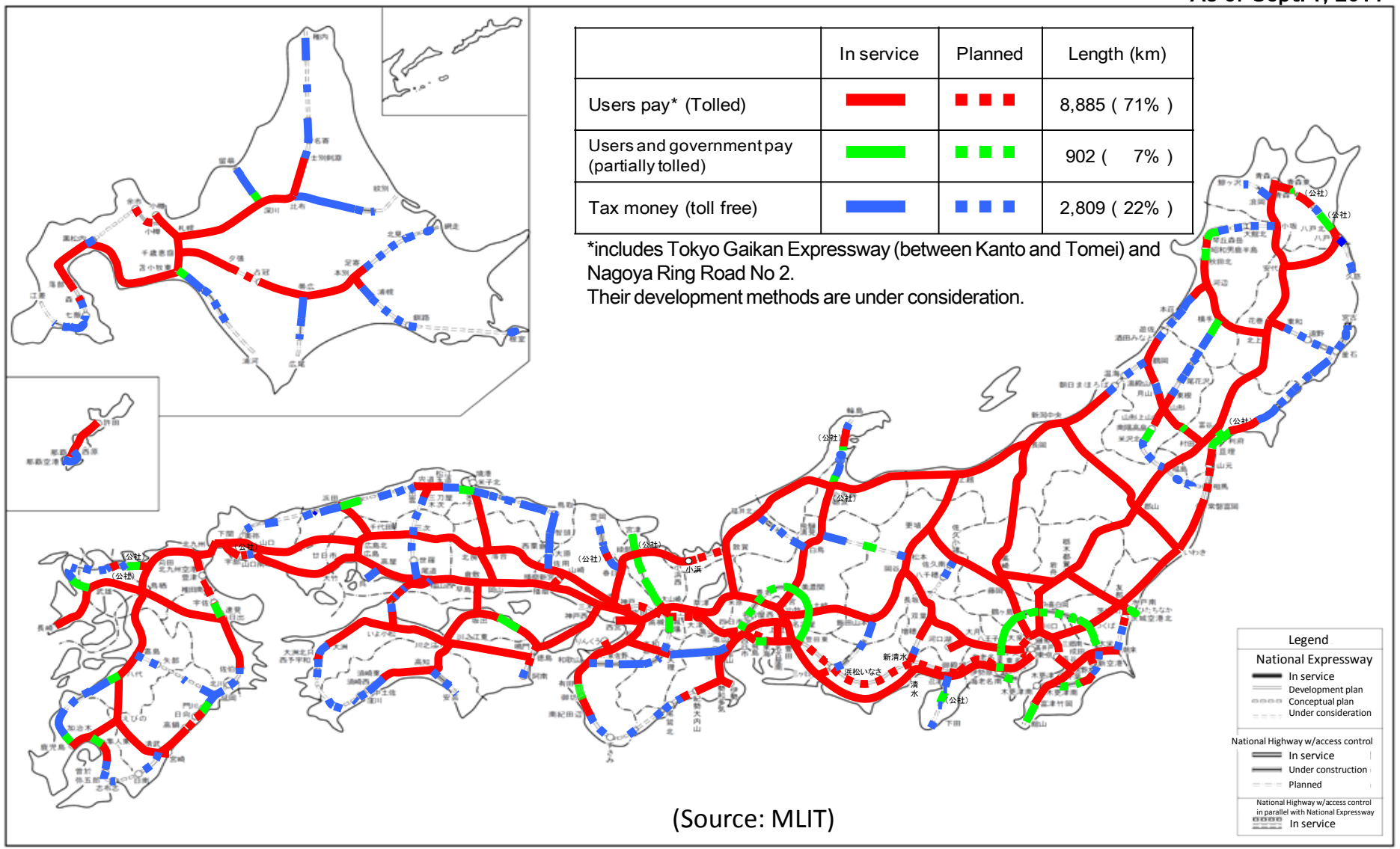
Toll and Toll-free Roads in Current Arterial High-standard Highway Network

- As of April 6th, 2012, 10,021km of arterial high-standard highways are in service, 87% are tolled and only 13% are toll-free although considerable toll free arterial high-standard highways will be open in marginal areas.
- Expressway development in Japan has relied heavily on a toll road system.

As of Sept. 1, 2011

	In service	Planned	Length (km)
Users pay* (Tolled)			8,885 (71%)
Users and government pay (partially tolled)			902 (7%)
Tax money (toll free)			2,809 (22%)

*includes Tokyo Gaikan Expressway (between Kanto and Tomei) and Nagoya Ring Road No 2.
Their development methods are under consideration.



(Source: MLIT)

Entity in Charge of Toll Road Development
- Japanese system was efficient to develop nation-wide network -

Form of Entity *Countries where Practiced*	Advantages	Disadvantages
Government Agency *Indonesia, Malaysia, Philippines, Thailand, and United States*	Facilitation of planning for network expansion.	Competing demands for government funds and difficulty in providing incentives to improve cost effectiveness and operational efficiency.
Public Corporation *Japan, Indonesia, Thailand, France, and the Philippines**	Greater effectiveness relative to private companies in pursuing goals set by the government, and their ease of accepting cross subsidies among routes in a network.	Lack of incentives for cost reduction, and tendency to be less efficient than their private counterparts. Due to tight governmental control, less effective in responding to market conditions, which change over time and differ across regions.
Private Concessions *Argentina, Brazil, Chile, Colombia, France, Hungary, Mexico, Spain, Hong Kong SAR (China), and the United States, among others*	Often favored over Government agencies because of their efficiency and market responsiveness.	Network development can be more difficult compared with public agencies. Private firms may not be able to assume all the risks associated with toll road development, which entails a long-term and large-scale investment.
Private-Public Partnership (PPP) Approach *Hungary, Colombia,* China, *Indonesia, and Philippines*	Brings additional resources to the project and complete it in a shorter time. Increases the efficiency in construction and project operation, through market discipline, assuring that the project is completed on schedule and within the budget.	Requires clear and justifiable definition of responsibilities between the public and private sectors.

* Strictly speaking both SEMCAs in France and PNCC in the Philippines are “semi-public” bodies, but with a majority of shares held by the public sector.

(Source: “Asian Toll Road Development Program,” the World Bank and the Japanese Ministry of Construction, 1999)

Features of the Japanese System
- Toll Road and Highway Public Corporations -

☐ Redemption Principle

- Full cost must be recovered by users charges.
- To cope with difficulty in keeping this principle on unprofitable routes, extension of redemption periods, pooling system and cost reduction efforts have been adopted.

☐ Cross Subsidies ("pooling" system) for Network Expansion

- Toll revenues of profitable routes are used to cross-subsidize unprofitable routes.
- This system has been effectively worked to expand expressway network.

☐ Strengths and Weaknesses of Public Corporation

- Effective to develop nation-wide network, Government tight control

☐ Strong Government Support

- Treasury Investment and Loan (utilizing postal savings & pension reserves),
- Government Equity Capital & Interest-free Loans,
- Subsidies for Interest Payment,
- Hybrid of Toll Road Projects and General Road Projects

Cross Subsidies (“pooling” system)

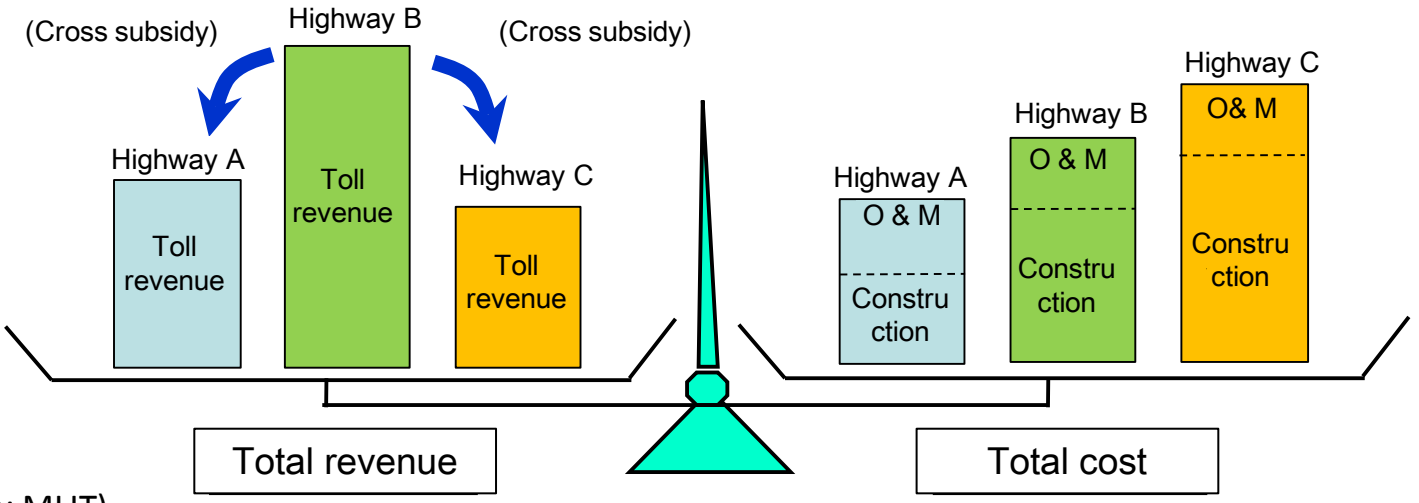
Recommendation of Road Council, 1972

1) Expressways should be an arterial traffic network, connected to each other across the country. Each link is not necessarily considered independent. Therefore, the toll rates should remain consistent and integrated.

2) Under the circumstance with development costs being affected largely by fluctuation of land prices and construction costs, cost differentiation due to project start time should be avoided. In addition, debt repayment should be carried out smoothly.

⇒Shifting from individual profitability system to pool system seems effective.

[Pool System]



(Source: MLIT)

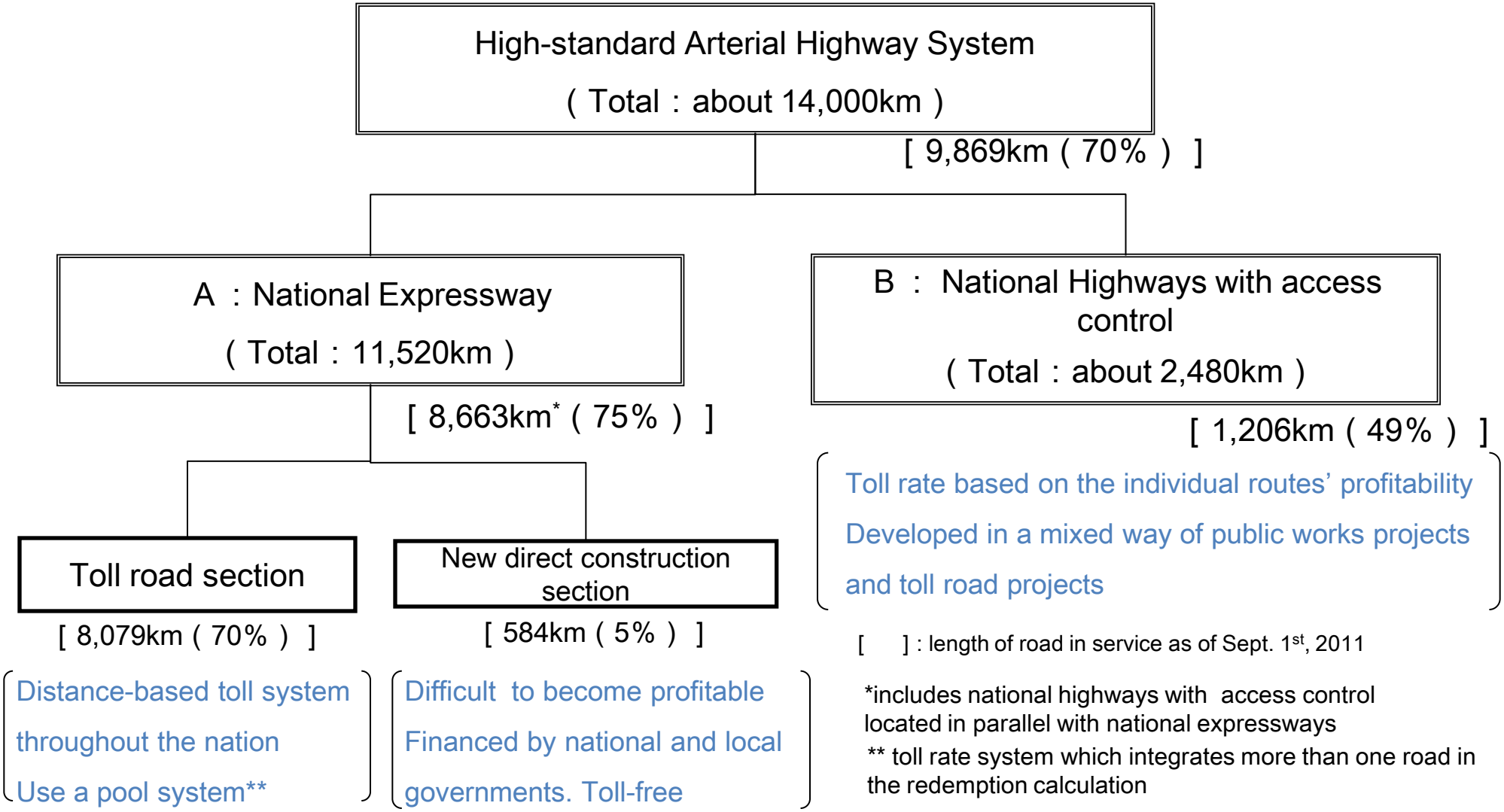
Change in Debt Repayment Period and Toll Rate (Tolled Expressways)

Rate revision	Oct. 1972	Apr. 1975	Aug. 1979	Jun. 1982	Oct. 1985	Jun. 1989	Apr. 1995	Apr. 1999	Dec. 2001	Oct. 2005
Main reason for rate revision	Introduction of pool system	-Addition of new road segments -Increase in construction cost		-hike in prices -Low traffic demand	-Addition of new road segments -Increase in construction cost				Reorganization and rationalization plan for special public corporations	Privatization
Subject Road Length	3,895km	4,816km	5,415km	5,415km	5,777km	6,410km	7,887km	9,006km	9,342km	9,342km
Minimum rate for passenger car	8.0 JPY/km	13.0 JPY/km (100 JPY)	16.6 JPY/km (100 JPY)	19.6 JPY/km (100 JPY)	21.7 JPY/km (100 JPY)	23.0 JPY/km (150 JPY)	24.6 JPY/km (150 JPY)			24.6 JPY/km (150 JPY) Fixed
Repayment period	About 30 years Fixed						40 years (Jun 1992 ~)	45 years (Jan 1999 ~)	Up to 50 years or shorter	45 years (up until 2050) Fixed

(Source: MLIT)

Finance of High-standard Arterial Highway System

- Utilizing National and Local Governments Funds -



[ ] : length of road in service as of Sept. 1st, 2011

*includes national highways with access control located in parallel with national expressways

** toll rate system which integrates more than one road in the redemption calculation

(Source: MLIT)

Government Support – Interest Subsidies and Equity -

➢The Government provides JHPC with subsidies for interest payments and equity capital to minimize risks associated with interest rate fluctuations.
➢The support needed to keep the interest payments at a certain level has been funded through a combination of direct subsidies and equity capital.

$$\text{Real Funding Cost} = \frac{\text{Interest Payment} - \text{Interest Subsidies}}{\text{Debt} + \text{Equity Capital}}$$

Planned Funding Cost

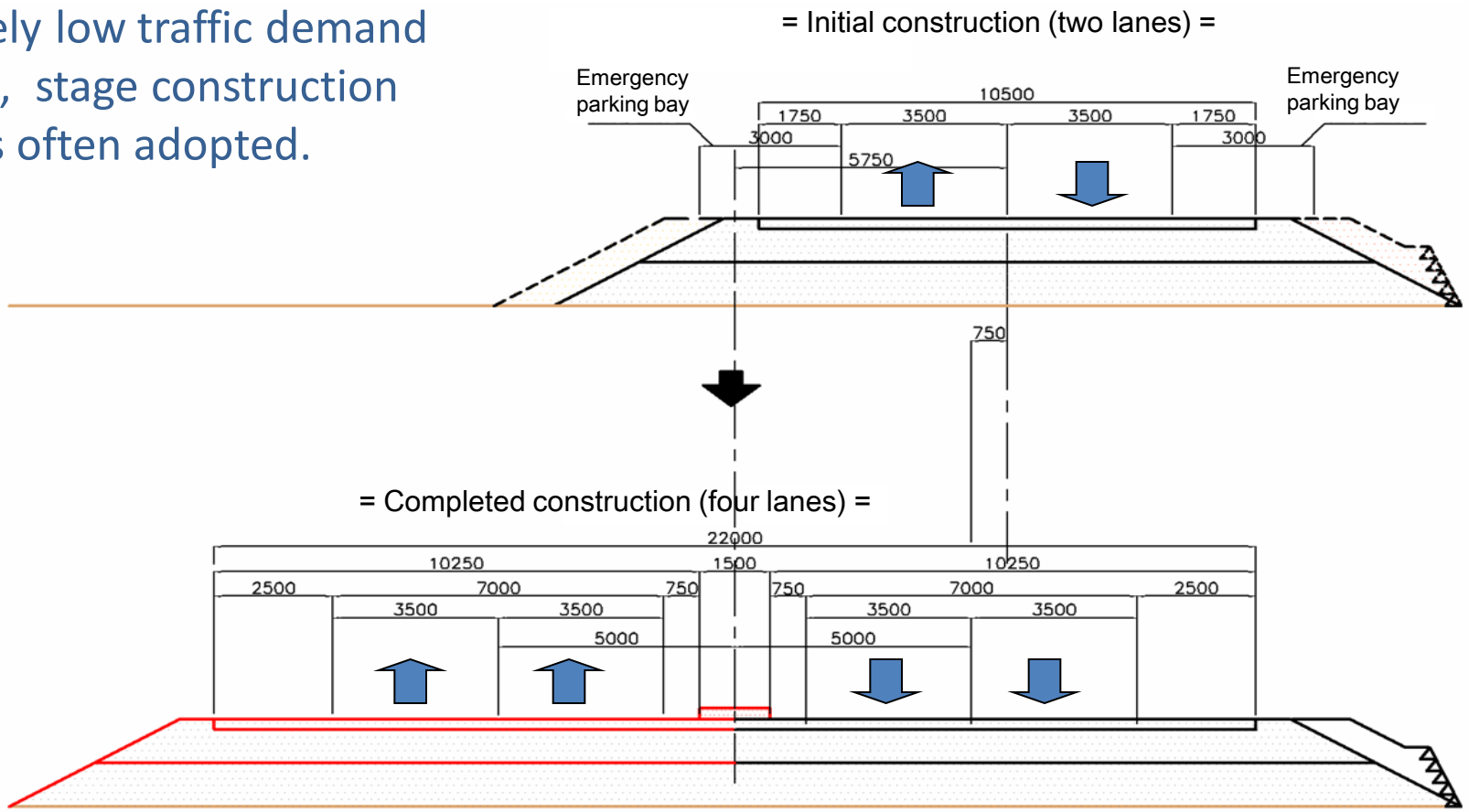
Fiscal Year	Other Expressways (%)	Rib-like Expressways (%)
19656-72	6.0	–
1983-93	6.5	3.0
1994	5.3	3.0
1995	5.2	3.0
1996	4.9	3.0
1997	4.7	3.0
1998	4.3	3.0
1999-2000	3.0	3.0
2001	3.0	2.9

✓The Government provided JHPC with Interest subsidies and equity capital in every fiscal year until 2001 so that a real funding cost was equaled to a planned funding cost. The total of interest subsidies amounts to 1.68 trillion JPY.

✓The Expressway Holding Agency received capital in the amount of 50.82 billion yen from the national and local governments of the Metropolitan Expressway and Hanshin Expressway, and lent 33.91 billion yen to the Metropolitan Expressway Co., Ltd, and 16.92 billion yen to Hanshin Expressway Co., Ltd., in interest free loans.

Cost Reduction of Expressway Construction
- Example of stage construction -

To reduce initial construction cost of relatively low traffic demand segments, stage construction scheme is often adopted.

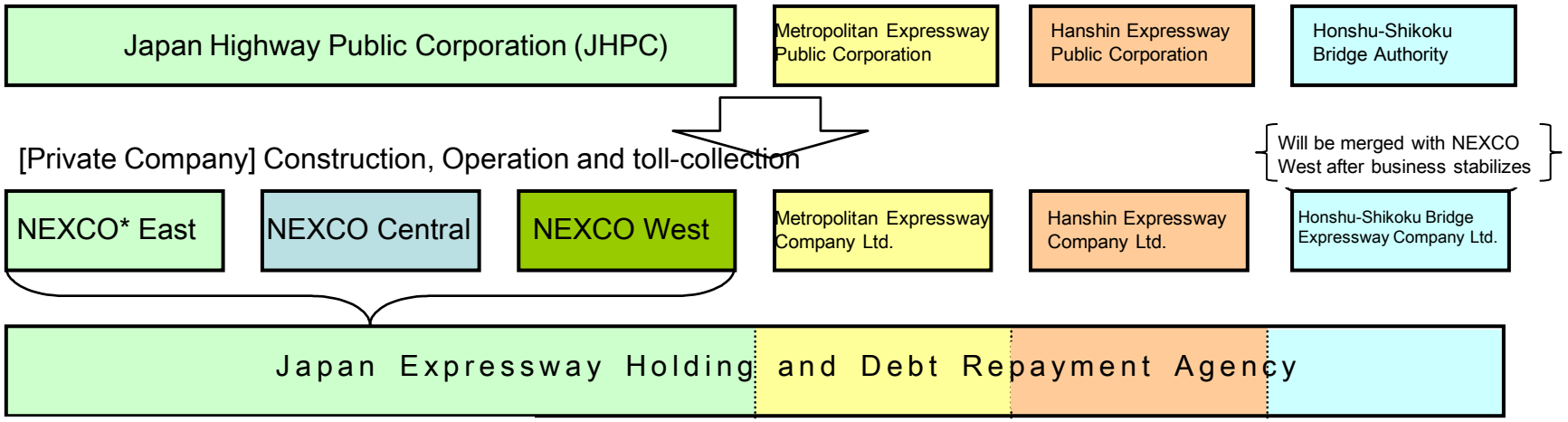


Concept of stage construction of earthworks

Organizational Chart: Post Privatization

Objectives of Privatization

-Keep up with the repayment of 40 trillion JPY
-Construct necessary roads promptly with the least national burden, while supporting individual initiatives of the expressway companies.
- Provide various and flexible toll rate settings and services taking advantage of being a private company.



4 Acts Related to Privatization of Former Highway Public Corporations

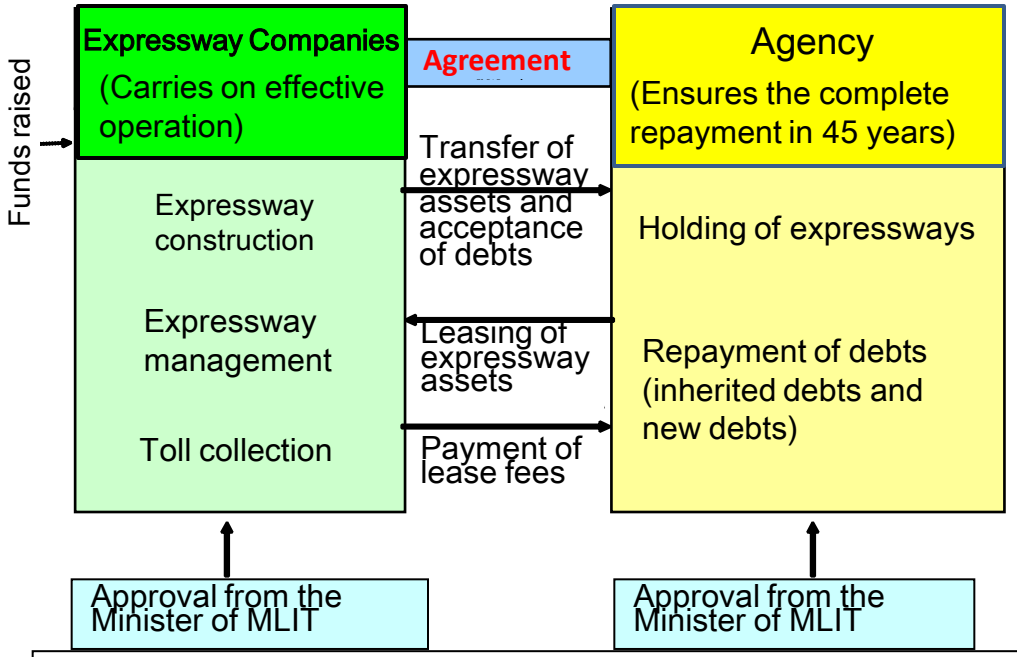
-Expressway Company Act
-Japan Expressway Holding and Debt Repayment Agency Act
-Act regarding the Development of Highway-related Acts in connection with the Privatization of the Japan Highway Public Corporation
- Act for Enforcement of Acts Related to Privatization of the Japan Highway Public Corporation, etc.

*NEXCO: Nippon Expressway Company

(Source: MLIT)

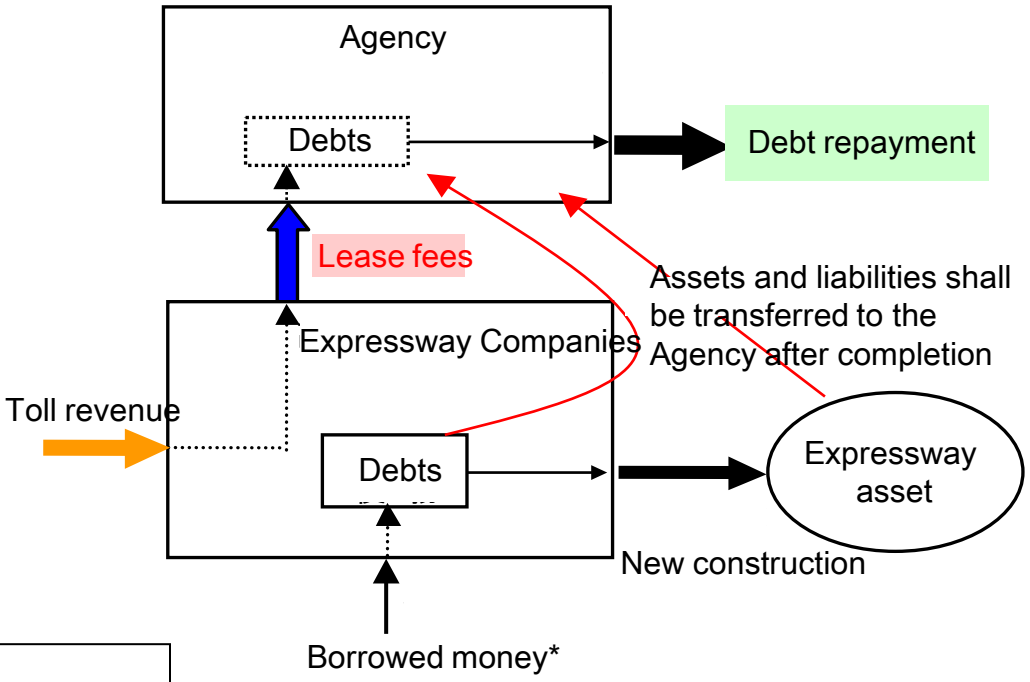
Business Scheme

-Expressway Companies are responsible for constructing new roads funded by debt and loans before transferring expressway assets and debts to the Agency.
-The Agency is responsible for completing the repayment of debts with the revenue of lease fees in 45 years.



< Responsibilities of the Agency >
・ Holding and Lease of expressway assets
(property tax is exempted based on the premise of free service in the future)
・ To ensure early repayment of the debts

Reduced national burden
To support expressway companies to carry out smooth business



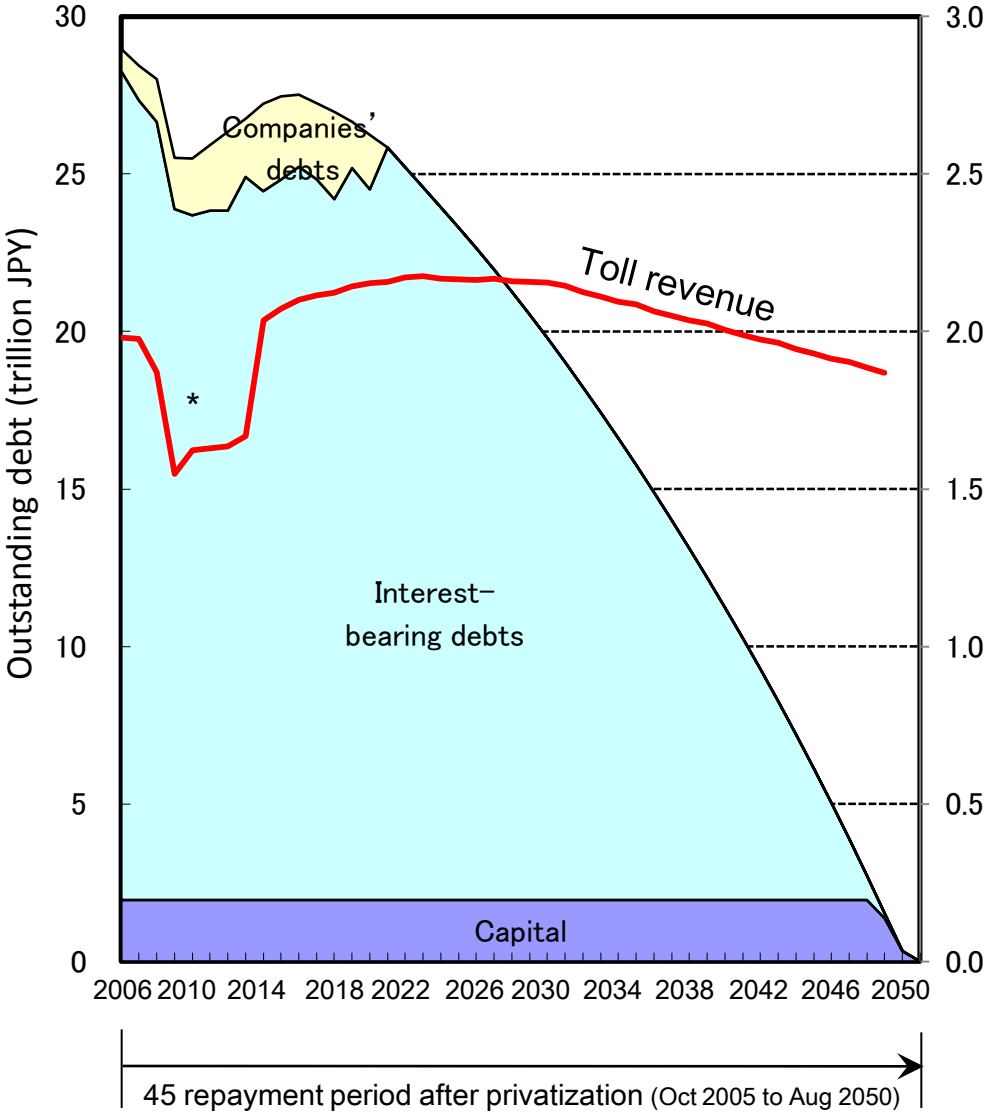
*borrowed from both national and local governments for construction (and this money is loaned to the companies at no interest)

(Source: MLIT)

Repayment Plan of the Debts of Expressway Development Costs

Change in outstanding debt
【nationwide (3 NEXCOs combined)】

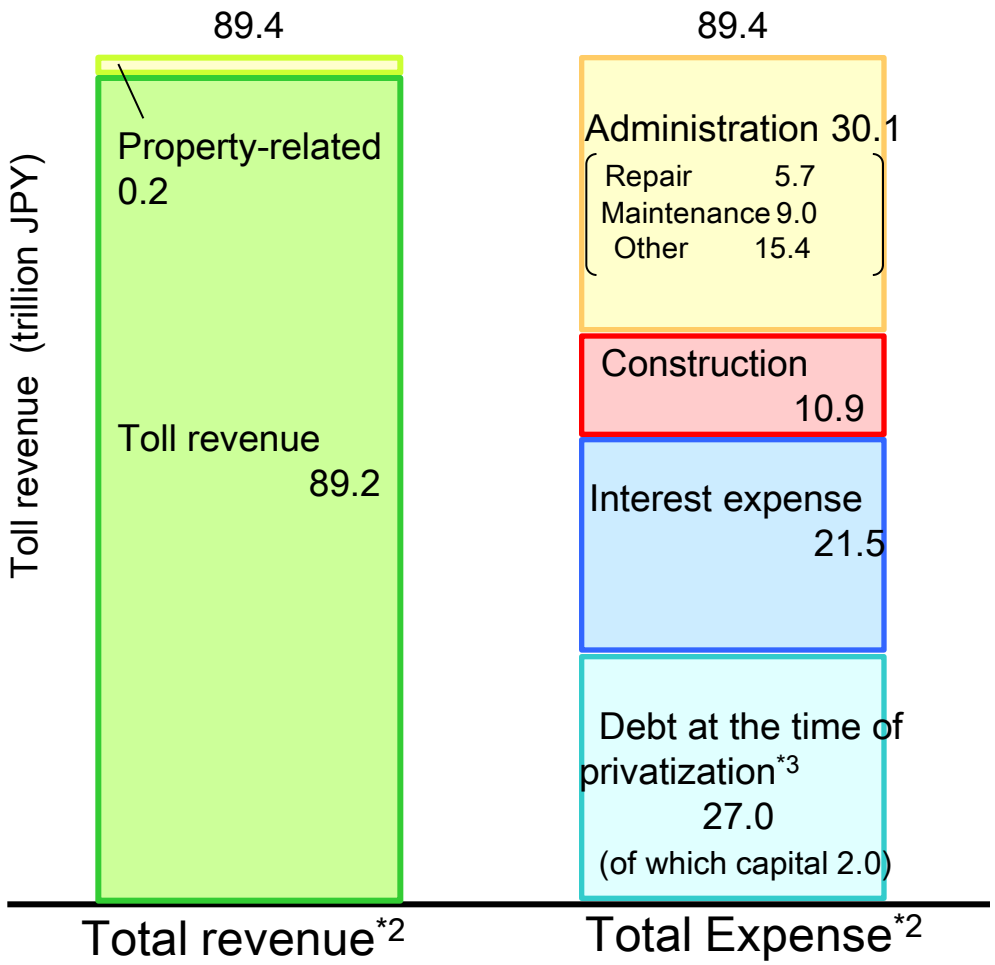
Note: based on the agreement of Jun 2011



*1: Reduction in revenue due to promotion of convenience

Balance of income and expenditure
【nationwide (3 NEXCOs combined)】

[unit: trillion JPY]



*2: Totals from 2006 to 2050.
*3: Reflects reduced debts due to promotion of convenience

(Source: MLIT)

Consequences of the Privatization in 2005

- MLIT direct construction of national expressways, under which national and local governments funds are allocated to be toll free, has been implemented since 2005 to develop not financially viable, but economically viable routes.
- As of now, the Privatization system works relatively well, so construction of new routes and repayment of debts proceed steadily.
- The Agency and the Companies can secure low cost funds because of their higher credit ratings, stable toll revenues and steady interest bearing debt repayment.

■ Changes in debt balance in FY 2011

(Japan Expressway Holding and Debt Repayment Agency)

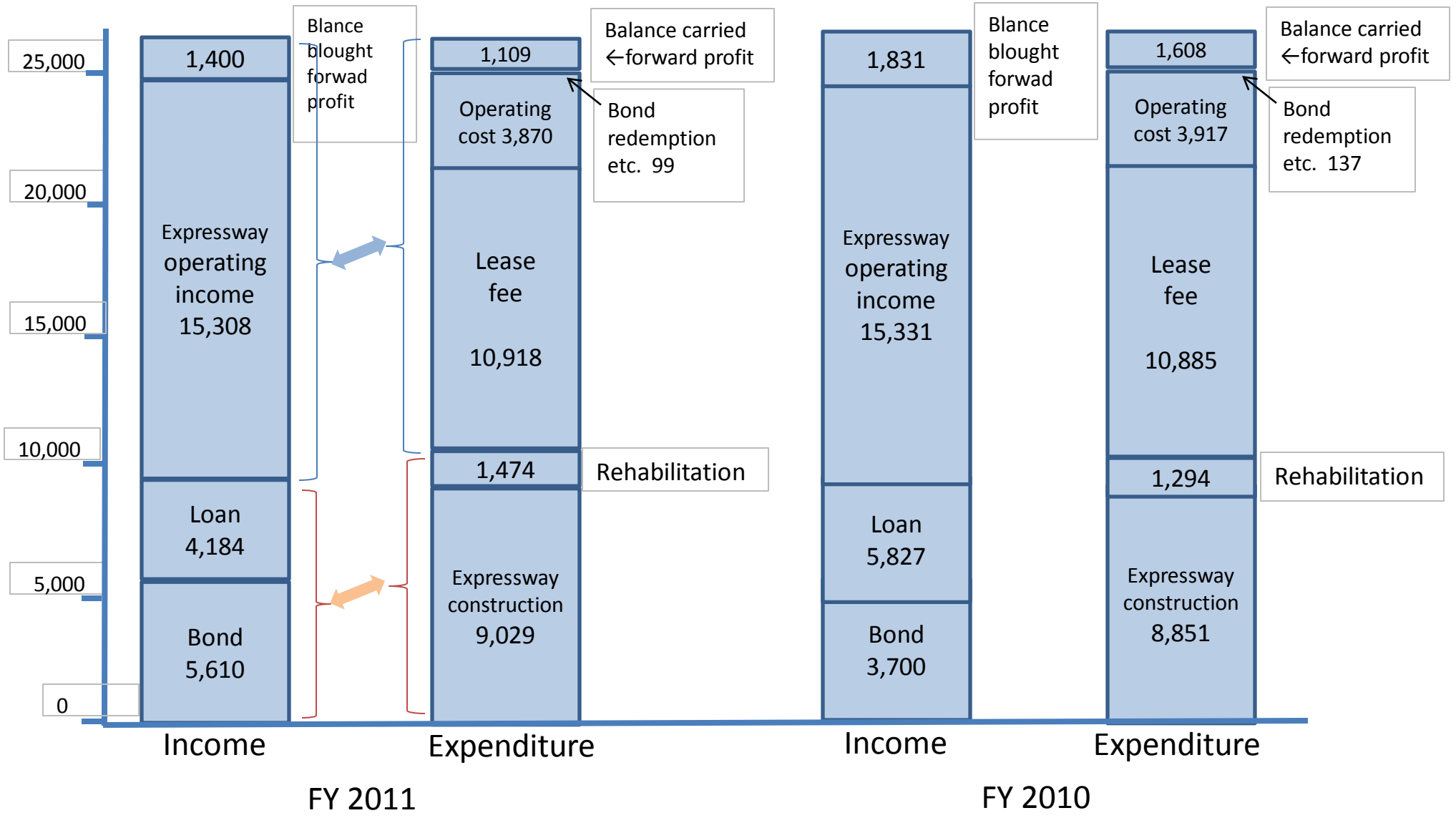
(Unit: 100 million yen)

	FY 2011	(Reference) FY 2010
Debt balance at start of the period A	306,799	312,870
Debt accepted B	4,807	5,625
Debt repaid C	34,104	4,903
Fund raised D	25,637	29,105
Increase in book value from the amortization of the discount on bonds payable E	105	102
Debt balance at end of the period A+B-C+D+E	303,244	306,799

From October 1st, 2005 to the end of FY 2000. the average fund-raising cost of interest-bearing debt was 1.50% .

(Source: The Japan Expressway Holding and Debt Repayment Agency)

Budget Plan of 3 NEXCO Combined



(3 NEXCO companies have not raised fund by FILP bond or FLIP agency Bond since FY2010.)

Case of Korea

1. The 4th Comprehensive National Territorial Plans (2000-2022)

(Guidelines for Expressways)

(1) Develop balanced national land and gradually develop a national expressway system consisting of 7 north-south expressways and 9 east-west expressways.

(2) Alleviate the bottleneck spots on national highways by saving freight costs and minimizing inconvenience.

Total length of Expressways : about 1,900km (1997) → about 6,000km (2020)

2. The 2nd Road Development Basic Plan (2011)

Total length in the plan: 6,160km

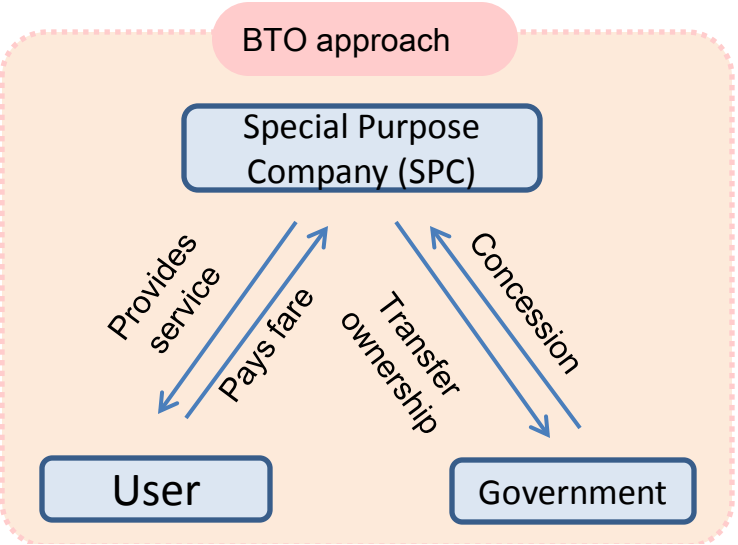
< Development Goals >

- Early development of national arterial roads that enables access from anywhere in the country to expressway within 30 minutes
- Development of the congested road segments, operation of facilities in an effective manner and better transport system in urban areas.
- Development of safe roads with coordination between human and environment
- Improvement of service for road users including better utilization of cutting-edge technology and information technology.

Reference: MLIT prepared based on "ROAD in KOREA 2002" (Website of Korean Ministry of Transport)

3. Project Scheme through Private Finance Initiative in Korea

- In 1994 the Government enacted the PPP Act to accelerate infrastructure development by overcoming government budget constraint and slow bureaucratic decision-making.
- BTO toll road projects along with unsolicited bidding (private sector proposal initiative) actively started in expressway development 2000 – 2006 because government supports such as MRG were substantial.



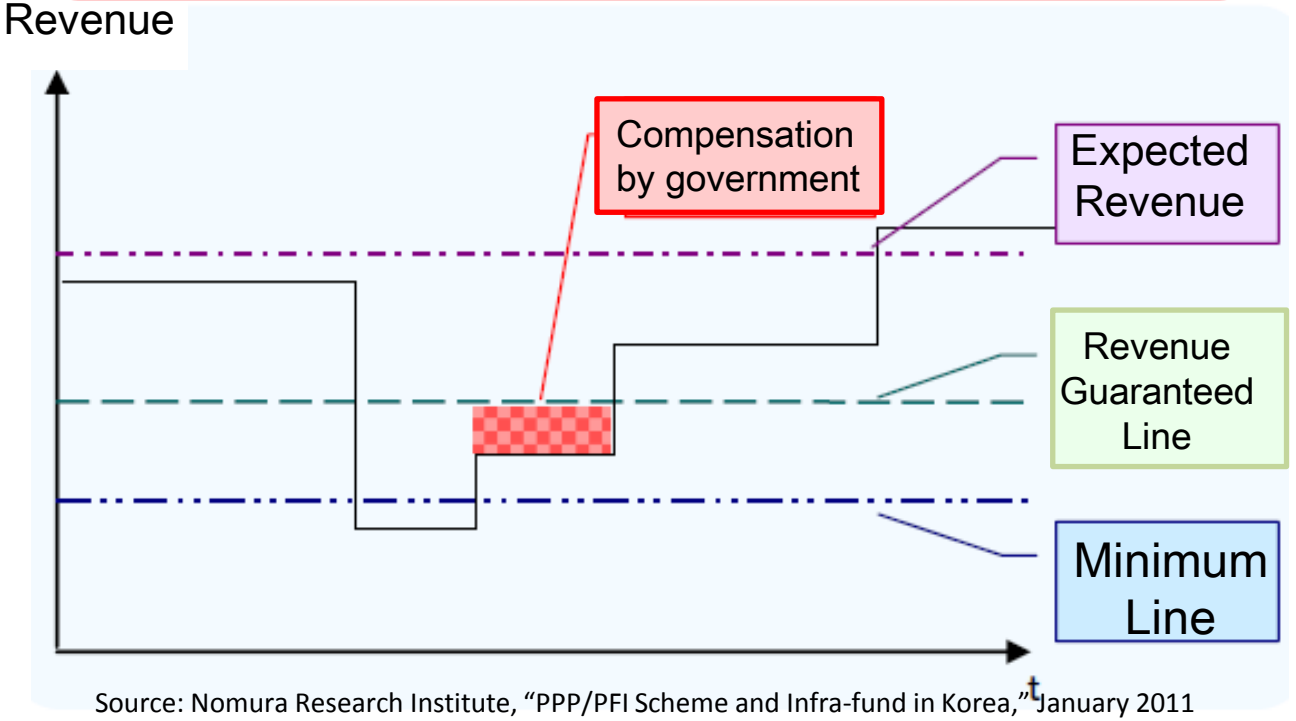
Reference: a document prepared by Korea Development Institute

(Source: Nomura Research Institute, "PPP/PFI Scheme and Infra-fund in Korea," January 2011)

Case of Korea - MRG as Government Support -

- Minimum Revenue Guarantee (MRG) is said to be a key government facility to support PPP.
- Governments undertake a certain portion of demand risk such as the difference between expected and actual toll revenue.
- However, there was criticism to PPP such as "SPCs undertake financially unviable projects since they are supported by excessive MRG."
- To cope with the criticism, the PPP Act, amended in 2003, introduced the "Minimum Line," which would define minimum revenue to be fulfilled to get MRG.
- Furthermore, MRG has been applied to only limited projects since 2007 due to PPP Act amendment in 2006.

Mechanism of Minimum Revenue Guarantee (MRG)



Source: Nomura Research Institute, "PPP/PFI Scheme and Infra-fund in Korea," January 2011

Revision of MRG Policy

	1999 Amendment	2003 Amendment	2006 Amendment
Period of coverage	Whole project period	15 years	10 years (Government approved projects only)
Revenue Guaranteed Line	90% - 80% of expected revenue	Ratio to expected revenue # First 5 years: 90% # Next 5years: 80% # Last 5 years: 70%	Ratio to expected revenue # First 5 years: 75% # Last 5years: 65%
Minimum Line	None	50% of expected revenue	50% of expected revenue

Source: Nomura Research Institute, "PPP/PFI Scheme and Infra-fund in Korea," January 2011

Case of China

1. National Trunk Highway System (NTHS) Plan

- To connect prefectural center cities with a population of 0.2 million or more in the next 30 years.
- To develop 7 radial roads, 9 north-south roads and 18 east-west roads centering around the capital city.
- Total length will be about 85,000km, of which 68,000km is arterial roads and 17,000km will consist of 5 local ring roads.

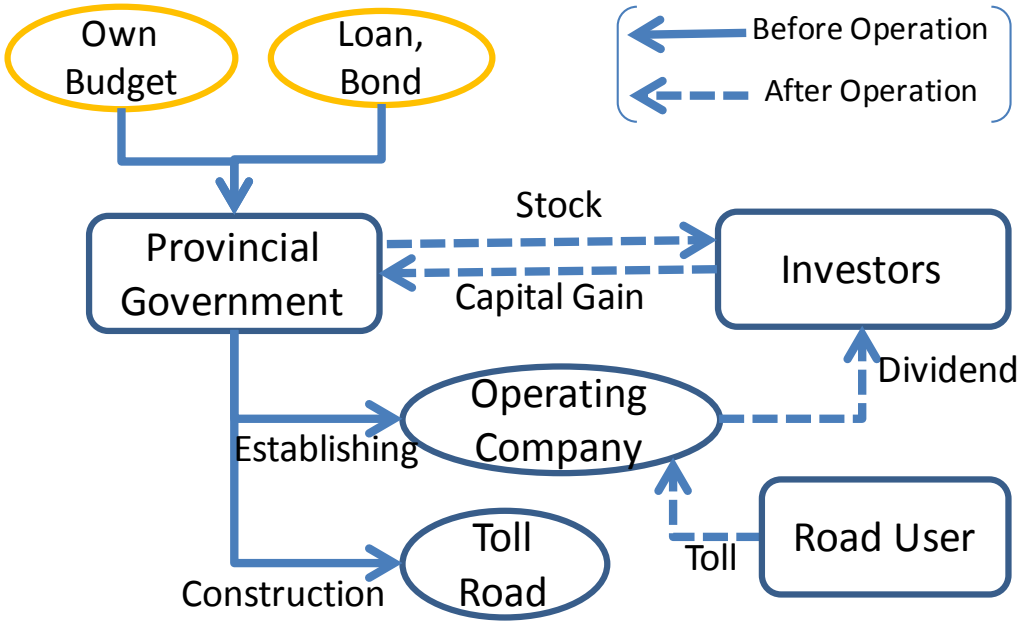
Planned road length about 85,000km

Opened road length about 74,000km
(as of the end of 2010)

(Source: MLIT)

2. Utilizing PPP and Toll Road

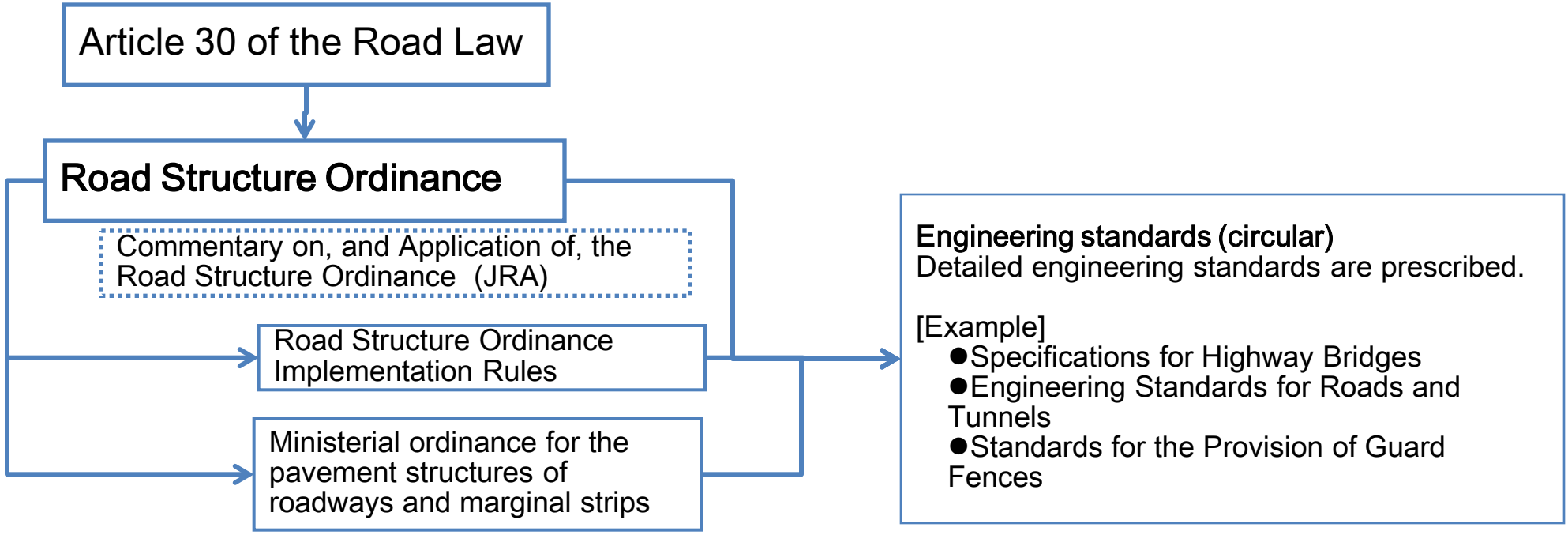
- The government of China has adopted a toll-based network and used debt as a key financing vehicle.
- While management and finance of most of the expressway network remains in the public sector, China has adopted a unique form of PPP for a limited projects.
- Provincial governments first build a toll expressway. After it is completed and most construction & traffic risks have matured, an expressway company is set up. Then the government sells the company's shares, on which shareholders earn dividends.



Note: Prepared based on Cesar Queiroz and Henry Kerali, " A Review of Institutional Arrangements for Road Asset Management: Lessons for the Developing World," The World Bank Transport Papers, April 2010

Technical Standard -Road Structure Ordinance -

- Basic highway design and engineering standards in Japan including those of expressway are prescribed as government ordinance, ministerial ordinance or ministerial circular by the Government and MLIT.
- The Japan Road Association (JRA) and other relating association also prepare detailed highway design and engineering guides and handbooks.
- Each Expressway Company also prepares design manuals for itself, complying with government standards.
- The most basic standard, the “Road Structure Ordinance” is a government ordinance based on Articles 30 of the Road Law.



Operation & Management

Traffic Control

*Monitoring traffic conditions

*Processing and providing traffic information

*Instructing patrol staff and other relevant teams

*Monitoring and controlling facilities

Toll Collection

*Ensuring to open toll gate for traffic volume

*Responding to accidents, disasters and illegal tollgate pass-throughs

*Rectifying equipment problems and other issues

Traffic Operation

*Conducting routine patrols

*Collecting traffic information

*Regulating traffic, responding to accidents and handling other on-site activities

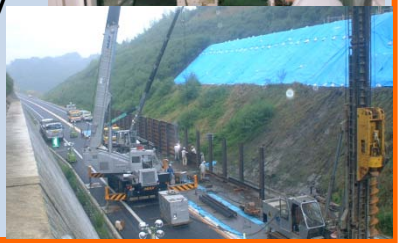
Road Operation & Maintenance

*Inspecting pavement, bridges, tunnels, slopes, facilities and buildings

*Cleaning, planting, cutting and trimming greenery

*Performing accident recovery work, removing snow

*Maintaining pavement, bridges, tunnels, slopes, facilities and buildings



Source: Hideki TAKAHASHI “Traffic Engineering and Traffic Management & ITS in NEXCO central,” NEXCO central

O&M -Traffic Control -

Incident Occurs

✓accident

✓vehicle breakdown
✓road obstacles
✓vehicle fire

✓traffic congestion

✓anomalous weather
✓disaster

Collect Information

●Manual collection

- ✓CCTV Camera
- ✓Traffic patrol
- ✓Emergency Telephone

●Automatic collection

- ✓ Traffic counter
- ✓ Meteorological observation station

Process the Collected Information

●Traffic Control Center (traffic control room)

Provide Information

✓ Variable message signboard

✓ Highway Radio
✓ VICS
✓ Information terminal at rest area

Provide Instructions to Onsite Staff

✓ Lane/road closure
✓ Accident clearance
✓ Towing of disabled vehicles
✓ Clearance of road obstacles

Share Information

✓ Police, fire department
✓ Road Traffic Information Center
✓ Media, other organizations

Source: “Kawasaki Traffic Control Center,” Central Nippon Expressway Limited

O & M - Emergency Work of Traffic Patroller -

The following drivers are notified of the accident that happened.

We secure the safety of customers at the site of the accident, regulating oncoming traffic.

Aid to customers
- To call police, fire-fighting, ambulance, etc.
- To arrange a towing vehicle to come

Are you O.K.?
Please wait for a while outside the guardrail.

Source: “Kawasaki Traffic Control Center,” Central Nippon Expressway Limited

O & M -Removing Fallen Objects and Obstacles-

Two members of the traffic patrol will remove the obstacles on the expressways.

You are liable for the objects and obstacles on the expressways if you drop them.

One member waves a flag, and another picks them up.

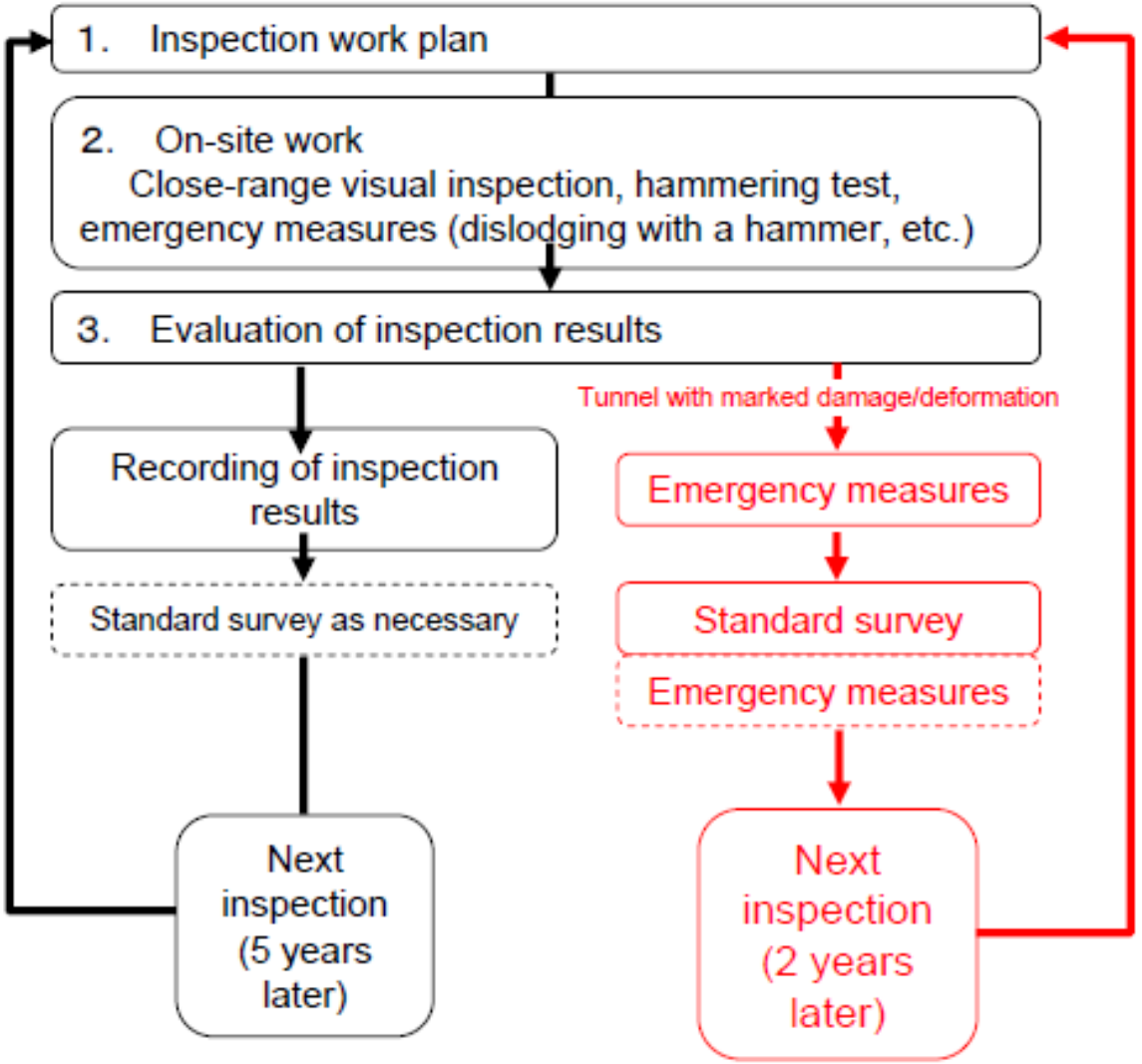
You realize how big they are.

They may cause a serious accident.

Source: “Kawasaki Traffic Control Center,” Central Nippon Expressway Limited

O & M - The Cycle of Planning-Inspection-diagnosis-repair -

【 Inspection flow-chart】



Close-range visual search for cracking

An inspection vehicle carries out non-destructive testing

Keiichi INOUE " The maintenance of national road network in Japan -Budgetary resources and medium and long term implications-" PIARC 2012.4.3

O&M – Technology Transfer -

MLIT & Expressway Companies together with JICA are extending Technical Cooperation for Expressway O&M in Developing Countries (ex. Vietnam, Sri Lanka & India)

Field training on lane closure in emergency case (Sri Lanka)

Actual lane closure in emergency case by staff of Road Development Authority, Sri Lanka

(Photo: JICA Sri Lanka Office)

Source: EOM&M Division, Road Development Authority, Sri Lanka, "Manual for Expressway Traffic operation & Management," January 2012

Technologies - Bridge Construction -

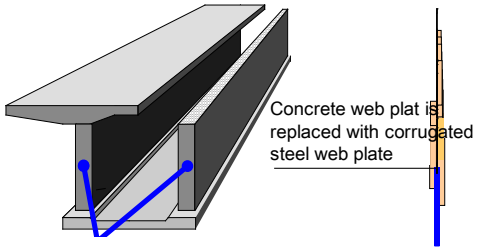
In accordance with the various settings, such as bridges between precipitous mountains or a viaduct in urban areas, bridges are constructed economically and appropriately.

Bridgework in a mountainous area

Construction of viaduct in an urban setting

Weight reduction with corrugated steel plate for bridge superstructure

Weight and cost can be saved by applying light-weight corrugated steel for web plate part in the PC box girder.



Concrete web plate

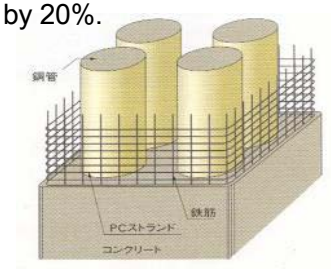
Corrugated steel web plate
New type of web

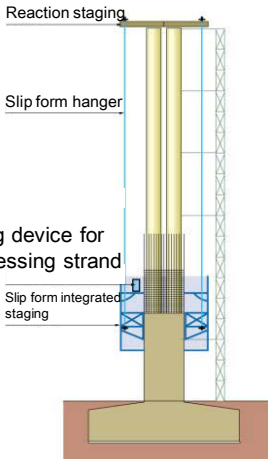
Reduction of construction period with use of steel pipes for bridge pier

Conventional method

New method

Application of steel pipes to reinforced concrete bridge pier enables less reinforcing work, better workability and cost-saving by 20%.





(Source: Japan Expressway International Company Limited)

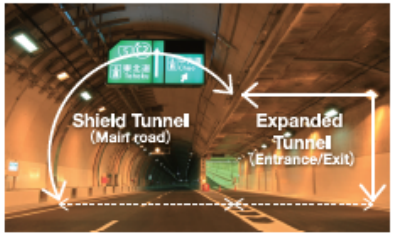
Technologies - State of Art Tunneling -

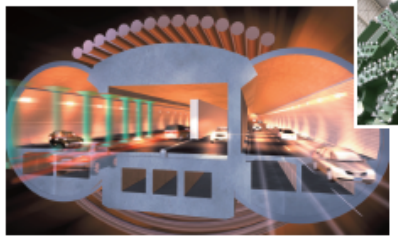
Construction of Hida Tunnel with Tunnel Boring Machine (TBM)

Length	10.7km : 2nd longest in Japan , 8th longest in the world
Diameter	12.84m
Excavation speed	Maximum 15m/day

•Construction at Urban Area 2

Shield Tunnel Expansion Method



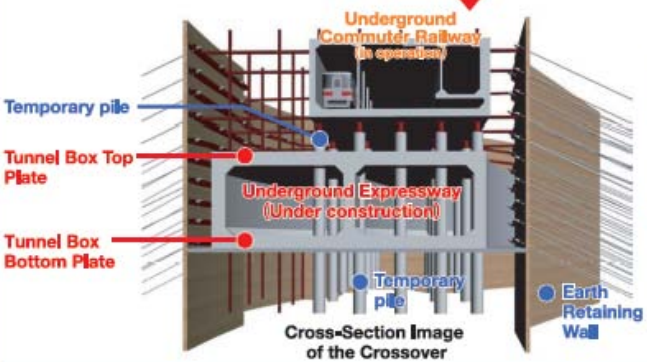


Shield Tunnel Boring Machine

The merging/diverging sections of entrance/exit were constructed by "Shield Tunnel Expansion Methods" at deep underground without open-cut from surface of the ground.

•Construction at Urban Area 1

Open Cut Tunneling Method directly underneath live Underground Railway
(Hanshin Expressway Kobe-Yamate Route)

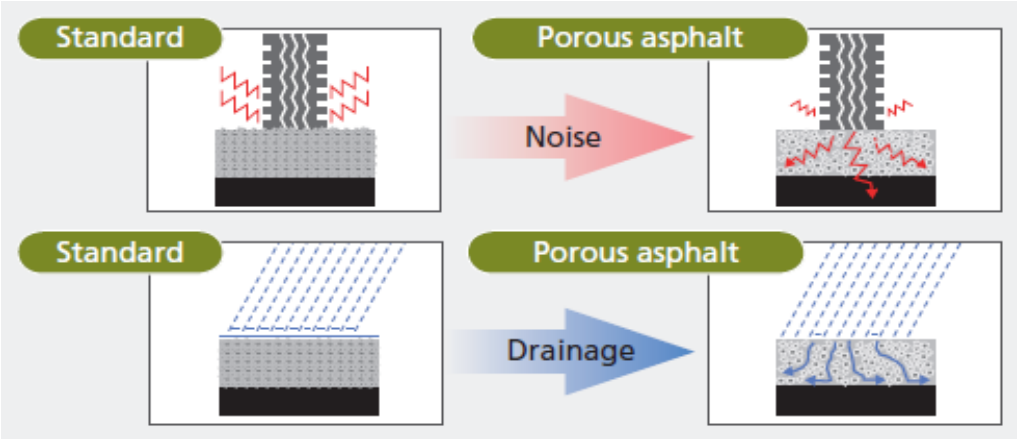


Cross-Section Image of the Crossover

(Source: MLIT, JEXWAY and 6 Expressway Companies "Expressway Construction-2, Tunnel," PIARC Mexico 2011)

Technologies - Pavement -

Multifunctional asphalt pavement has a lot of small holes compared to conventional asphalt pavement that enables better permeability and noise-absorption effects, which ultimately enhances safety at high speeds. Additionally, the quality of pavement is accurately controlled.



Pavement surface roughness test

Roughness of the pavement surface is measured by moving the wheel longitudinally over the pavement and thus keeping high pavement quality.

(Source: Japan Expressway International Company Limited)

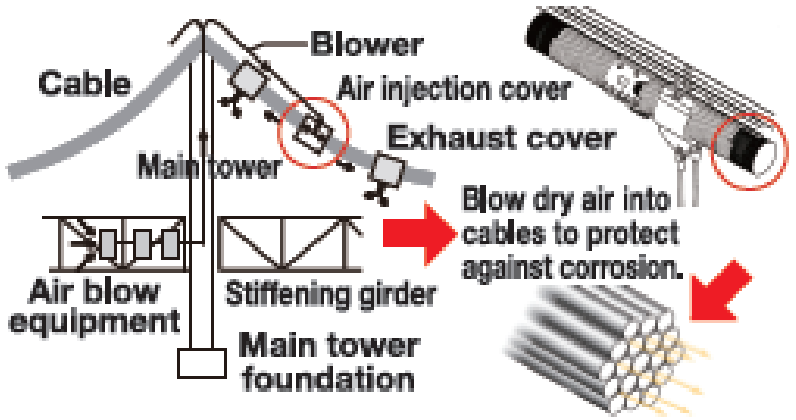
Technologies - Maintenance of Cable Suspension Bridge -

Rust Prevention Technology 1

- Preventing corrosion of cables -

•A dry air injection system was developed. The system prevents corrosion of main cable suspension bridge by supplying dry air into the sealed cable.

•Good results have been already given for existing suspension bridges as well as newly built ones



Main cable

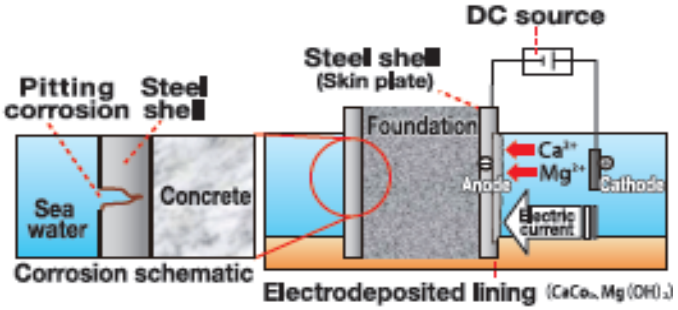
Air injection cover

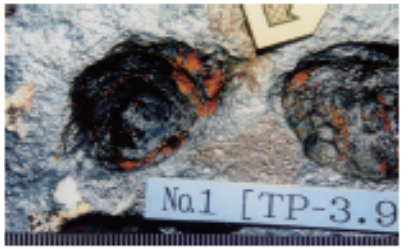
Rust Prevention Technology 2

- Protecting undersea structures from rust

•Electrodepositing technology was developed to protect undersea steel structures against corrosion and keep durability.

•Small electric current is flowed through the seawater to deposit ions in the seawater to deposit of the undersea structure, thus protecting it against corrosion.





Corrosion in undersea structure

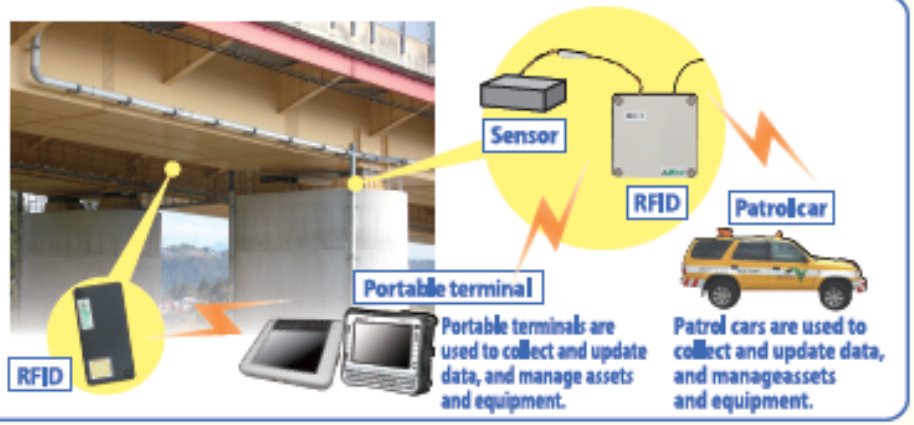
(Source: Honshu-Shikoku Bridge Expressway Company Ltd. “Maintenance Technologies for Suspension Bridge,” PIARC Mexico 2011)

Technologies - Structure Maintenance -

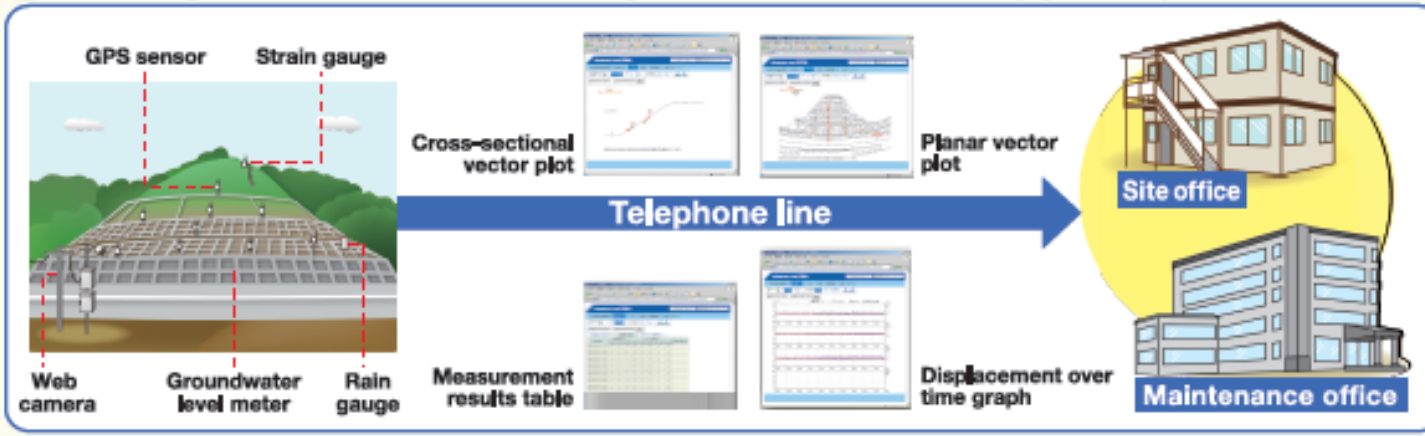
Example of system constructed to enhance efficiency of inspection and management operations

Ubiquitous road maintenance information collection system

A ubiquitous environment that uses RFID and sensors mounted on road infrastructure is being built to enable access "anytime, anywhere" to information necessary for road inspections and maintenance. The objectives are to enhance efficiency of inspection and management operations, and speed up customer services. This technology uses HDVs and infrared cameras to conduct noncontact, nondestructive tests of bridge conditions from a remote location.



Conceptual view of road slope maintenance support system



(Source: MLIT, JEXWAY and 6 Expressway Companies "Expressway Maintenance-1," PIARC Mexico 2011)

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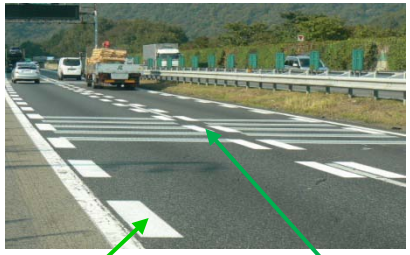
Technologies -Traffic Safety Facilities -

Example



Guiding lane mark

Reduction mark

Rough layer of pavement

Rotary light

Warning sign

Arrow sign

Visual guidance sign

Warning signs indicating the line's end have been operating in the Okazaki area of the Tomei Expressway since 2009 using traffic counters, sign boards and blue lights.

Blue-colored light

Congestion warning sign

< Congestion warning system >

Source: Hideki TAKAHASHI "Traffic Engineering and Traffic Management & ITS in NEXCO central," NEXCO central

Technologies - Emergency Work for Rehabilitation -

Restoration work to damaged road section after large-scale disasters

Example of restoration work after the Great East Japan Earthquake of Mar. 11, 2011

Just after earthquake occurred

Restoration work 3 days after the earthquake

Re-open to traffic (6days after the quake)

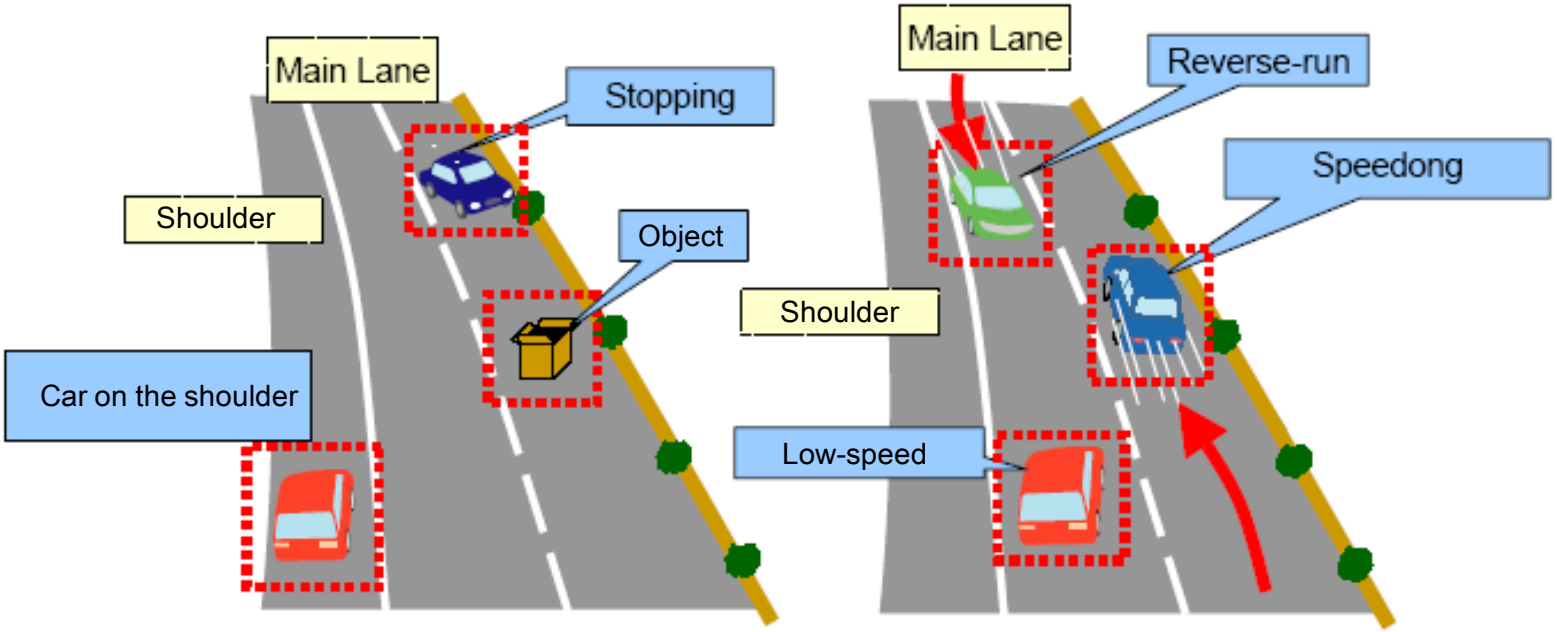
《Emergency transport route》
Emergency squad and goods were transported using the expressway the day following the disaster.

《Logistic support》
Provide rest areas along the expressway near the damaged areas for Self-Defense Forces and Fire Services as a restoration work base.

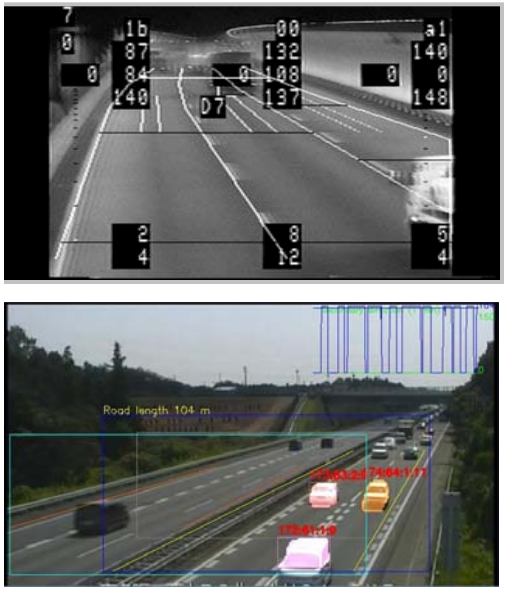
(Source: NEXCO east & Japan Expressway International Company Limited)

Technologies - Detecting by Camera Image Processing -

Detecting emergent events, traffic situations (amount, speed and congestion etc.) by using camera image processing



Intended emergent events in the proving test



Detecting by image processing

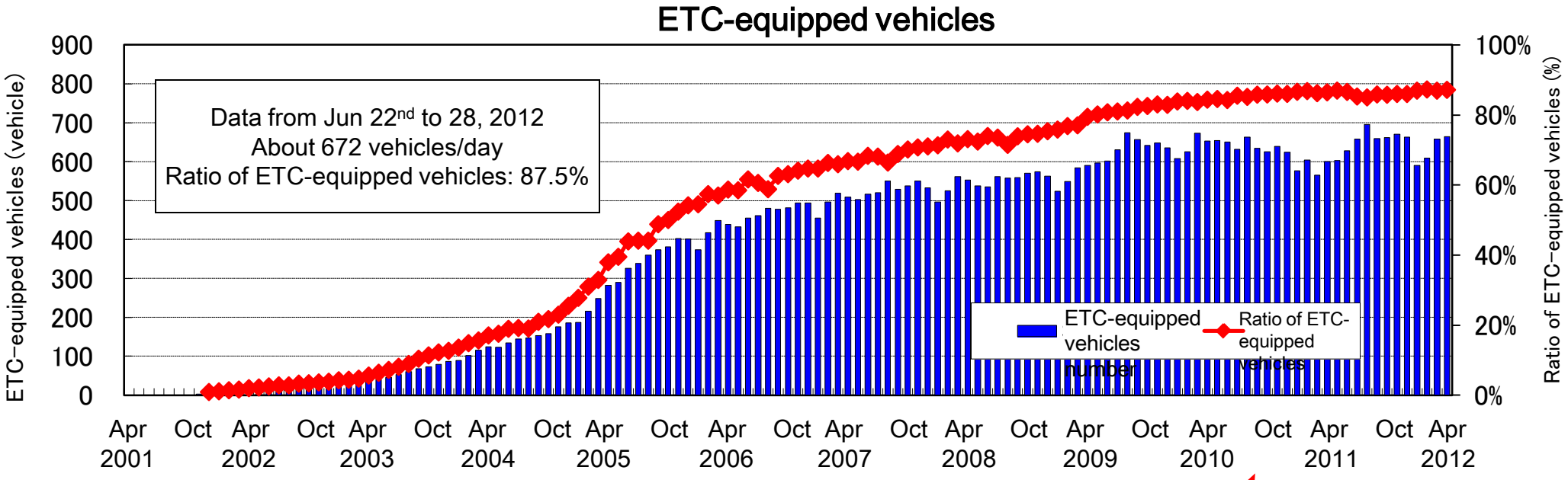
Emergent events : “Stopping,” ”low-speed,” “evacuating-run,” ”run on shoulder,” ”fallen object”

< Results of field tests (provisional) >

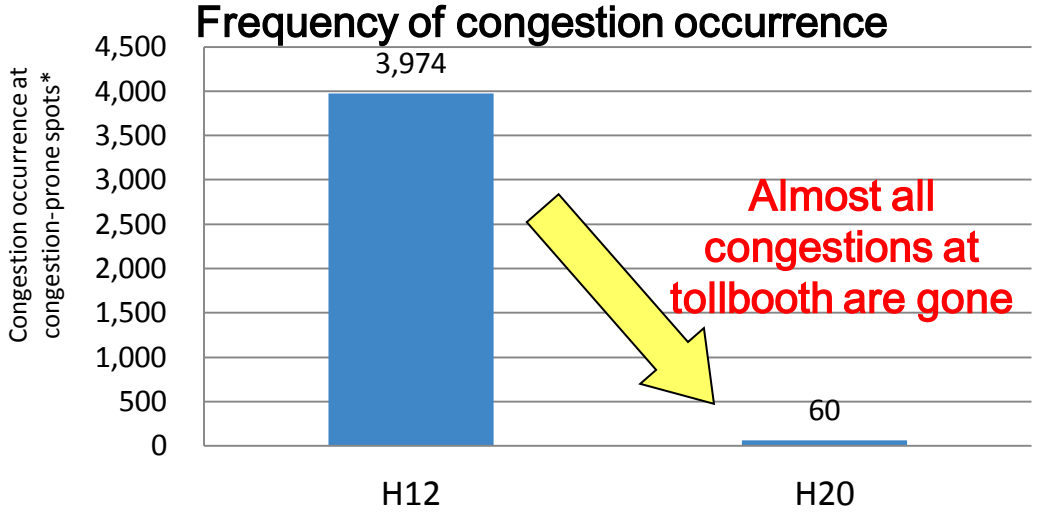
- Detection of the car action, such as “evacuating-run,” ”run on shoulder,” etc. is good at night and day
- Detection of falling objects is difficult

Source: Hideki TAKAHASHI “Traffic Engineering and Traffic Management & ITS in NEXCO central,” NEXCO central

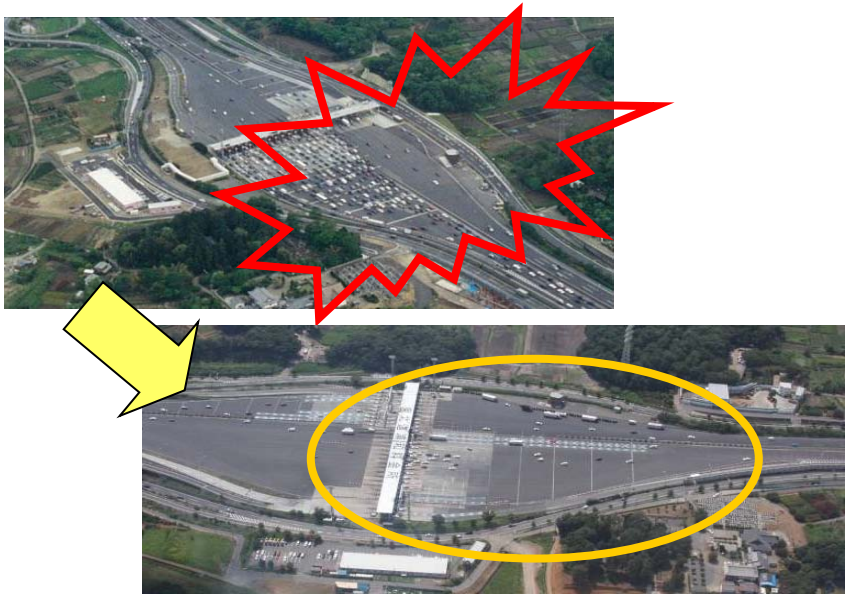
Technologies - Electronic Toll Collection (ETC) System -



Note: Data on the expressways managed by the Expressway Companies



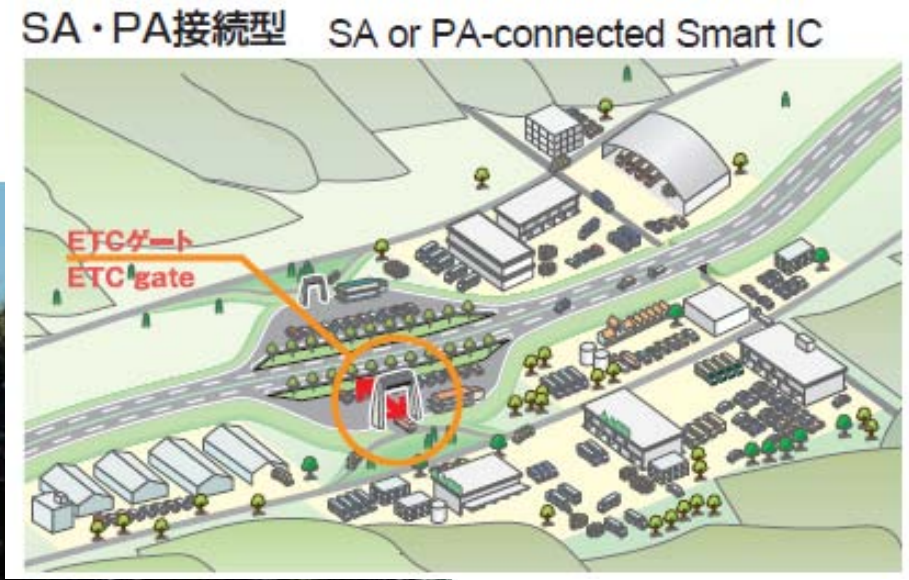
*a segment that experiences more than 30 congestions or 5 congestions with congested length of 2km or more in a year



(Photo: Japan Expressway International Company Limited)

Technologies - ETC and Smart IC -

Smart IC is simplified inter change only usable ETC car.



Source: Hideki TAKAHASHI “Traffic Engineering and Traffic Management & ITS in NEXCO central,” NEXCO central

Technologies - Application of Japanese ETC Technology in Singapore -

ERP(Electronic Road Pricing)System

The World-first Automated Road Pricing System

Distinctive Features

- ■High Speed Multi-lane Free-flow
- ■Payment by Prepaid IC card in On-board Unit
- ■Dual mode IC card (contact and contactless)
- ■High Communication Reliability(99.999%)
- ■Charge amount depending on vehicle class including motorcycles
- ■Violation vehicle can be automatically identified by number plate recognition system
- ■High utilization Ratio of On-board Unit (99. 9%)

In Operation at about 90 Places In Singapore

Source: Mitsubishi Heavy Industries

EPS(Electronic Parking System)

Distinctive Features

- ■ Using ERP Technology
- ■ Deduct Parking Fee Thorough DSRC communication

In Operation at about 1,400 Places In Singapore

Source: Mitsubishi Heavy Industries


Thank you for your attention.
Oonaruto Bridge
built in 1985, L=1,629m