Expressways in Japan
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
Stipulated in the “National Development Arterial Expressway Construction Law”

Preliminary Plan
(Planned Route by the Law)

Basic Plan

Implementing Plan

Construction Order by the Minister*

(Highway Public Corporation starts a project)

Government Responsibility

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

Scope of segment; Major municipalities traversed; Standard No. of lanes; Design speed; Major connecting points; Proponent

Decision of city planning; EIA (if necessary)
Hearing opinion of concerning prefectures

Municipalities traversed; No. of lanes; Design speed; Connecting roads and their locations; Construction cost; Proponent

Design, Raising Fund, ROW Acquisition, Construction, Operation & Maintenance

*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.
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

(Source: MLIT)
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

- Expressway network accessible from any town/rural area in the nation within an hour
- A 30-minute travel time to most of the major air/sea ports
- 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)
-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

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

* 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)
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

- 70km/h or higher
- 60 ~ 70km/h
- 50 ~ 60km/h
- 40 ~ 50km/h
- Lower than 40km/h

<Travel speed between cities in Japan (based on probe data)>
(Source: MLIT)
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.

### International Comparison of Ring Road Development of Capital Regions

(Source: MLIT)

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

(Source: MLIT)
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

1952, 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)

1956, Full-fledged revision of the Law Concerning Special Measures for Highway Construction Act on Japan Highway Public Corporation was enacted.

1959, Act on the Metropolitan Expressway Public Corporation was enacted.

1962, Act on the Hanshin Expressway Public Corporation was enacted.

1970, 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)
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

<table>
<thead>
<tr>
<th></th>
<th>In service</th>
<th>Planned</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users pay* (Tolled)</td>
<td></td>
<td></td>
<td>8,885 (71%)</td>
</tr>
<tr>
<td>Users and government pay (partially tolled)</td>
<td></td>
<td></td>
<td>902 (7%)</td>
</tr>
<tr>
<td>Tax money (toll free)</td>
<td></td>
<td></td>
<td>2,809 (22%)</td>
</tr>
</tbody>
</table>

*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

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

* 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.

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
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)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Main reason for rate revision</td>
<td>Introduction of pool system</td>
<td>Addition of new road segments</td>
<td>Increase in construction cost</td>
<td>hike in prices</td>
<td>Low traffic demand</td>
<td>Addition of new road segments</td>
<td>Increase in construction cost</td>
<td>Reorganization and rationalization plan for special public corporations</td>
<td>Privatization</td>
<td></td>
</tr>
<tr>
<td>Subject Road Length</td>
<td>3,895km</td>
<td>4,816km</td>
<td>5,415km</td>
<td>5,415km</td>
<td>5,777km</td>
<td>6,410km</td>
<td>7,887km</td>
<td>9,006km</td>
<td>9,342km</td>
<td>9,342km</td>
</tr>
<tr>
<td>Minimum rate for passenger car</td>
<td>8.0 JPY/km (100 JPY)</td>
<td>13.0 JPY/km (100 JPY)</td>
<td>16.6 JPY/km (100 JPY)</td>
<td>19.6 JPY/km (100 JPY)</td>
<td>21.7 JPY/km (100 JPY)</td>
<td>23.0 JPY/km (150 JPY)</td>
<td>24.6 JPY/km (150 JPY)</td>
<td>24.6 JPY/km (150 JPY)</td>
<td>24.6 JPY/km (150 JPY)</td>
<td></td>
</tr>
<tr>
<td>Repayment period</td>
<td>About 30 years</td>
<td>40 years (Jun 1992 ~)</td>
<td>45 years (Jan 1999 ~)</td>
<td>Up to 50 years or shorter</td>
<td>45 years (up until 2050)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Source: MLIT)
High-standard Arterial Highway System

( Total : about 14,000km )

[ 9,869km ( 70% ) ]

A : National Expressway
( Total : 11,520km )

[ 8,663km* ( 75% ) ]

Toll road section
[ 8,079km ( 70% ) ]

Distance-based toll system throughout the nation
Use a pool system**

New direct construction section
[ 584km ( 5% ) ]

Difficult to become profitable
Financed by national and local governments. Toll-free

B : National Highways with access control
( Total : about 2,480km )

[ 1,206km ( 49% ) ]

Toll rate based on the individual routes' profitability
Developed in a mixed way of public works projects and toll road projects

* 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.

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

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Other Expressways (%)</th>
<th>Rib-like Expressways (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19656–72</td>
<td>6.0</td>
<td>-</td>
</tr>
<tr>
<td>1983–93</td>
<td>6.5</td>
<td>3.0</td>
</tr>
<tr>
<td>1994</td>
<td>5.3</td>
<td>3.0</td>
</tr>
<tr>
<td>1995</td>
<td>5.2</td>
<td>3.0</td>
</tr>
<tr>
<td>1996</td>
<td>4.9</td>
<td>3.0</td>
</tr>
<tr>
<td>1997</td>
<td>4.7</td>
<td>3.0</td>
</tr>
<tr>
<td>1998</td>
<td>4.3</td>
<td>3.0</td>
</tr>
<tr>
<td>1999–2000</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>2001</td>
<td>3.0</td>
<td>2.9</td>
</tr>
</tbody>
</table>

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

Concept of stage construction of earthworks
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.

Organizational Chart: Post Privatization

Japan Highway Public Corporation (JHPC)

[Private Company] Construction, Operation and toll-collection

NEXCO* East  NEXCO Central  NEXCO West

[Agency] Holding of expressways and repayment of debt

Japan Expressway Holding and Debt Repayment Agency

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)
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.

**Business Scheme**

- **Expressway Companies** (Carries on effective operation)
  - Expressway construction
  - Expressway management
  - Toll collection

- **Agency** (Ensures the complete repayment in 45 years)
  - Holding of expressways
  - Repayment of debts (inherited debts and new debts)

**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

Outstanding debt (trillion JPY)

Balance of income and expenditure
【nationwide (3 NEXCOs combined)】
[unit: trillion JPY]

89.4

89.4

Administration 30.1
  Repair 5.7
  Maintenance 9.0
  Other 15.4

Construction 10.9

Interest expense 21.5

Debt at the time of privatization*3 27.0
  (of which capital 2.0)

Total revenue*2
Toll revenue 89.2
Property-related 0.2

Total Expense*2

45 repayment period after privatization (Oct 2005 to Aug 2050)

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

(Source: MLIT)
Changes in debt balance in FY 2011

**(Japan Expressway Holding and Debt Repayment Agency)**

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

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

Income

Expressway operating income 15,308

Loan 4,184

Bond 5,610

Expenditure

Operating cost 3,870

Lease fee 10,918

Rehabilitation 1,474

Income

Expressway operating income 15,331

Loan 5,827

Bond 3,700

Expenditure

Operating cost 3,917

Lease fee 10,885

Rehabilitation 1,294

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

< 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.

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)
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)

- **Expected Revenue**
- **Revenue Guaranteed Line**
- **Minimum Line**

### Revision of MRG Policy

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

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

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.

(Source: MLIT)
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.

**Article 30 of the Road Law**

**Road Structure Ordinance**

- Commentary on, and Application of, the Road Structure Ordinance (JRA)
- Road Structure Ordinance Implementation Rules
- Ministerial ordinance for the pavement structures of roadways and marginal strips

**Engineering standards (circular)**

Detailed engineering standards are prescribed.

[Example]
- Specifications for Highway Bridges
- Engineering Standards for Roads and Tunnels
- Standards for the Provision of Guard Fences
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
The following drivers are notified of the accident that happened.

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

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

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

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

You realize how big they are.

They may cause a serious accident.

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

Source: “Kawasaki Traffic Control Center,” Central Nippon Expressway Limited
O & M - The Cycle of Planning - Inspection - diagnosis - repair -

1. Inspection work plan
2. On-site work
   - Close-range visual inspection, hammering test, emergency measures (dislodging with a hammer, etc.)
3. Evaluation of inspection results
   - Recording of inspection results
     - Standard survey as necessary
     - Tunnel with marked damage/deforation
     - Emergency measures
     - Standard survey
     - Emergency measures
     - Next inspection (2 years later)
     - Next inspection (5 years later)
     - An inspection vehicle carries out non-destructive testing
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)
In accordance with the various settings, such as bridges between precipitous mountains or a viaduct in urban areas, bridges are constructed economically and appropriately.

**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**

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 1

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

Construction at Urban Area 2

Shield Tunnel Expansion Method

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.

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

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.

(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

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.
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 (6 days 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)
Detecting emergent events, traffic situations (amount, speed and congestion etc.) by using camera 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 -**

**Data from Jun 22nd to 28, 2012**
About 672 vehicles/day
Ratio of ETC-equipped vehicles: 87.5%

**Frequency of congestion occurrence**

Almost all congestions at tollbooth are gone

*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*
Smart IC is simplified interchange only usable ETC car.

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

EPS (Electronic Parking System)

Distinctive Features
- Using ERP Technology
- Deduct Parking Fee Through DSRC communication

In Operation at about 90 Places In Singapore
Source: Mitsubishi Heavy Industries

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