

**REPUBLIC OF INDIA**

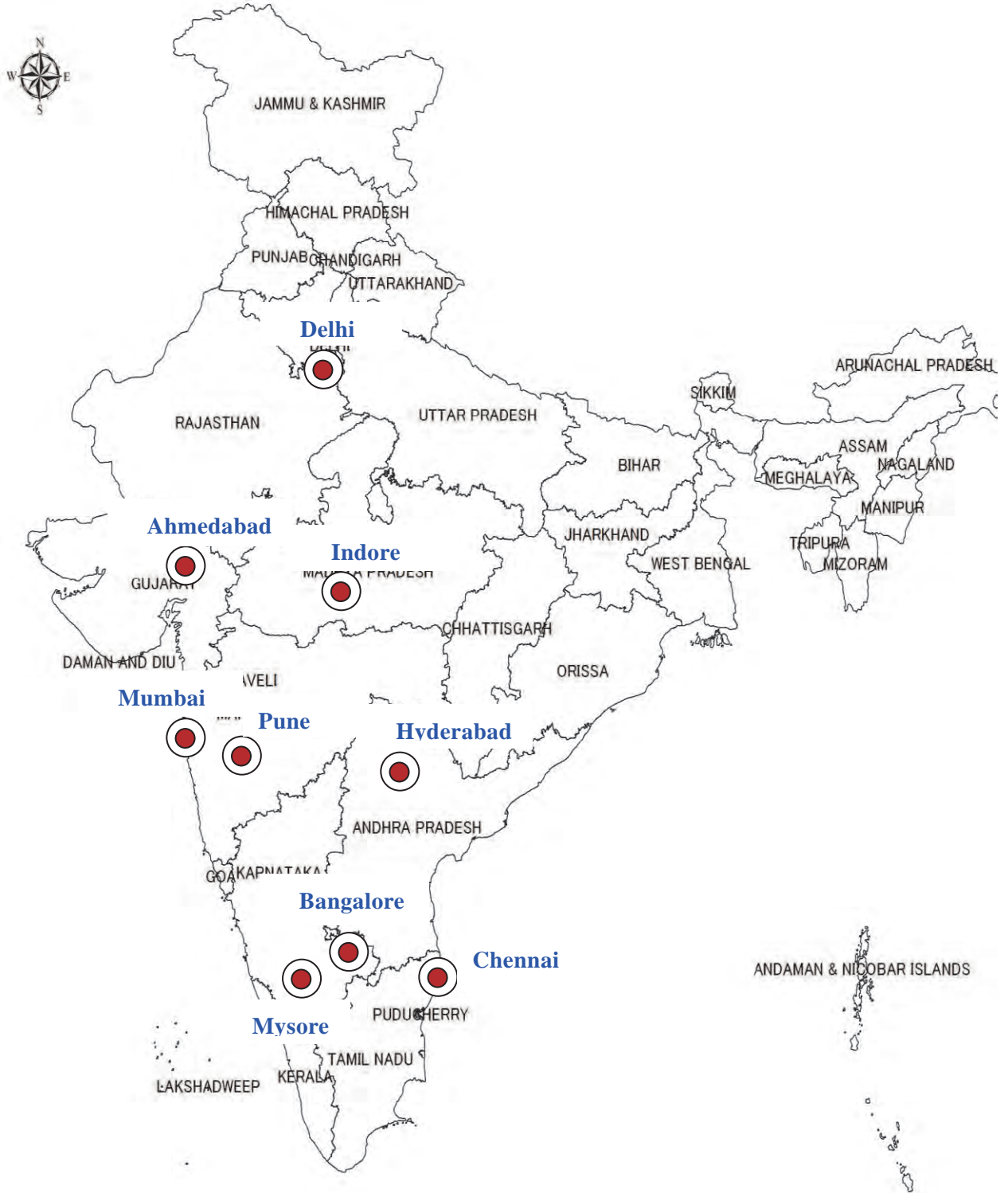
**DATA COLLECTION SURVEY  
ON  
THE INTRODUCTION OF  
INTELLIGENT TRANSPORT  
SYSTEMS  
TO  
URBAN TRANSPORTATION OF  
MAJOR CITIES  
IN  
INDIA  
  
FINAL REPORT**

**JANUARY 2013**

**JAPAN INTERNATIONAL COOPERATION AGENCY  
(JICA)**

<b>IDO</b>
<b>JR</b>
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# Location Map



## **Executive Summary**

### **(1) Study Objective**

The objective of the study is to conduct a thorough fact-finding on ITS being implemented/planned and related traffic/transport issues. It is intended to identify, based on the fact-findings, the major issues and challenges of ITS and make appropriate recommendations for effective introduction to the various Indian cities, and successful and sustainable implementations.

### **(2) Study Contents**

The study involved the extensive interviews with important stakeholders of ITS and transport sector across nine (9) cities in India. The related data/information as secondary means was further collected/obtained from the stakeholders, their portals, websites, magazines, journals and etc.

### **(3) Studied Cities**

The following nine cities were covered by the study. They were selected due to the reason that the ITS facilities are already in place at certain level and some major ITS related projects are in progress.

1) Delhi, 2) Ahmedabad, 3) Hyderabad, 4) Bangalore, 5) Mysore, 6) Chennai, 7) Indore, 8) Mumbai, and 9) Pune

### **(4) Observations**

#### **1) National Level**

Any high level strategies/plans of ITS such as national ITS master plan with long-term vision have not been formulated in India. The inter-ministerial organisation framework, cross-sectorial collaborative structure involving government, academia and industry are critical for promotion of ITS in India. This framework is not sufficiently in place yet.

Under such condition, the individual agencies such as traffic administrators, road administrators, public transport agencies are independently preparing their ITS facilities in the region.

#### **2) Regional Level**

Some ITS facilities exist in the nine cities. The existing ITS facilities in India have similarities. They are generally consisted by the following components;

- ✓ Traffic management system consisted by centre, CCTV and signals
- ✓ Enforcement systems mainly for traffic signal violations and over speed
- ✓ Bus, BRT operation/monitoring system
- ✓ Metro operation/monitoring system
- ✓ Taxi operation/monitoring system

## (5) Issues

The issues from view point of ITS are summarised as follows;

### 1) National Level

- **Planning: Absence of High Level ITS Strategy**

There is no high level strategy of ITS such as national level ITS master plan with long term vision. Under such situation, the ITS at regional level are being independently introduced.

- **Planning: Absence of National ITS Architecture**

The ITS Architecture is a framework which defines roles of the subsystems and data exchange amongst them to realise efficiently the required objectives of the systems. It includes ITS services which are to be offered to various system users. The national level ITS architecture were prepared in major developed countries including Japan, US, Canada and Europe. Such architecture does not exist in India yet. Thus, it is concerned that the systems become increasingly inefficient and inconsistent, consequently leading to higher cost due to double investment.

- **Institutional Framework: Inter-Ministerial Collaboration**

The inter-ministerial institutional framework is critical for promotion of ITS. The ITS taskforce was formulated in 2007, initiated by the Ministry of Urban Transport. However it was observed that the intuitional structure and capability were not sufficient yet. The substantial activities and discussions have not been sufficiently carried out yet.

- **Institutional Framework: Government, Industry and Academia Collaboration and International Network**

The collaboration amongst industry, government and academia, and international network are also critical for promotion of ITS, as well as the inter-ministerial collaboration. However, the institutional framework and nodal point for international activities are still weak in India.

### 2) Regional Level

#### (a) Road and Traffic Issues

ITS is one of the software measures, of which effect can be expected under the condition of certain maturity of infrastructures and traffic manner. In this view point, the following road and traffic issues are observed in India.

- **Road Infrastructure**

The road infrastructures are not properly prepared in the cities in India, although the conditions somehow differ by city. Except some limited areas in such cities as Delhi and Mumbai, the proper road infrastructure such as road alignment, lane-marking, intersection structure, footpath, pedestrian crossing, and etc., are not sufficiently in place. Moreover, a number of religious obstacles remain on the road at many locations in the cities in India, and they are adversely affecting the smooth traffic flow.

India can be called as 'vehicle prioritised society'. The spaces for the pedestrians are not adequately in place in the cities. The typical examples are extremely narrow sections and frequent missing sections of the footpaths along the road, a number of the obstacles stand-

ing in the middle of the sidewalk areas, unacceptably insufficient number of the pedestrian crossings, skywalks and pelican-crossings. The pedestrians are consequently forced to walk on the areas of the carriageway. Thus in India, the spaces for the vehicles and people are not clearly demarcated in the city, and the walking spaces are not practically functioning.

- **Traffic Manner**

The traffic manners in India are adverse condition. The typical examples are opposite driving, lane hogging, traffic signal violation, lane mark violation, riding motorbikes without helmet and excess number of the passengers and etc. Crossing road by the pedestrians are frequent scenes everywhere due to the absence of the spaces for the pedestrian in the city, as raised above.

- **Public Transport**

The urban mass transit systems such as metro, BRTS and monorail are increasingly developed in the major cities in India in recent years. However, the last mile connections which supplement the major transport, for example, between the residential areas and the stations of the trunk line of the public transport, are not satisfactorily in place. The connections which assure the transit to different transport mode such as parking around the stations and proximity of the bus and metro stations are not adequately arranged. Thus, the people select the road transport and, consequently, the traffic demand has not been adequately diverted to the public transport.

(b) **ITS Issues**

- **Planning: Absence of Regional ITS Strategy**

There does not exist any high level strategy of ITS at regional level such the regional ITS Master Plan with long term vision. Under such situation, the ITS introductions are independently underway. There is a risk that the inefficient system will be in place and double-investment resulting in unnecessary higher cost may occur.

- **Planning: Absence of Regional ITS Architecture**

The regional level ITS architectures are not prepared yet. It is expected that more or less similar kinds of the ITS menus may be required in the cities in India. However, the ITS architectures incorporating the regional requirement are necessary. The regional ITS shall be planned and deployed in accordance with such regional ITS architectures.

- **Institutional Framework: Absence of Cross-Sectorial Collaboration Structure**

A number of different agencies are involved for planning, introducing and operating ITS. In particular in the case of India, the jurisdiction is complicated. For example, the city government is responsible for installation and maintenance of the facilities, the traffic police is for operation. But the actual maintenance and operations are outsourced to the private agencies by these different governmental bodies. Thus, the cross-sectorial institutional framework is important for effective planning, introduction and operation of ITS particularly in India.

- **Management: Road Management and Facility Management**

The basic road information such as drawings is not sufficiently prepared and properly

managed by the agencies including the road administrator and planning agencies in India. Thus, a proper road management such as road network planning are not satisfactorily realised.

Many of the road side facilities such as traffic signals and CCTV are not working due to the insufficient maintenance. The major reason is a scarce financial resource for the maintenance. But also, the jurisdictional aspect can be one of the major causes for this, as well. For example in Japan, a single responsible department of road administrator or traffic administrators basically takes care of the roadside facilities throughout the entire cycle. However in the case of India, different agencies are intricately involved such as the city government which hold the ownership of the facilities, traffic police who use the as user, but the actual maintenance and operations are outsource to the private agencies by different government bodies. Thus, the facilities are left without proper care.

- **Technology: Utilisation of Quantitative Road Traffic Data**

The traffic management is solely dependant on CCTV monitoring in India and the systems for quantitative measurement on traffic by such methods as road side sensors and probe system are not in place. Therefore, the traffic conditions are not quantitatively comprehended and the measured traffic data is not utilised for generation of the dynamic traffic information and planning/evaluation for traffic, road infrastructure and urban development.

- **Technology: Other Related Environment Required for ITS**

The vehicle number plates are not standardised in India. They employ different materials, fonts, character sizes, languages, equipping positions on the vehicles and etc. It is technically difficult to automatically detect and recognise the number plate by the system in such condition. The vehicle registration database is developed by state, and it is not linked to any other systems such as driving licence mechanism, resident registrations and etc. Thus, enforcement is facing difficulties in tracing the violated owners such as the ones from other states, who changed his addresses and etc.

Based on the observations and issues identified above, the required measures and implementation schedule are proposed in the table on the next page.

**Table 1 Required Measures and Proposed Implementation Schedule**

Counter Measures	Schedule											Remarks		
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021				
National Level	Reinforcement of Inter-Ministerial Framework	■	■											
	Reinforcement of Collaboration amongst Industry, Government and Academia, and International Network	■	■											
	Preparation of Upper Level Plan of ITS		■	■	■									To be continuously carried out after completion of 1st edition (*)
	Preparation of ITS Architecture			■	■									To be continuously carried out after completion of 1st edition (*)
	Improvement of Accident Information Management and Nation-Wide Expansion		■	■	■	■								
	Improvement of Vehicle Registration			■	■	■	■	■						
	Standardization of Number Plate			■	■	■	■	■						
	Improvement of License System			■	■	■	■	■						
	Improvement of Road Management Information			■	■	■	■	■	■	■	■			
	Creation of Fund			■	■	■	■	■	■	■	■	■	■	To be continuously carried out in accordance with ITS expansion
	Capacity Building		■	■	■	■	■	■	■	■	■	■	■	To be continuously carried out
	Regional Level	Establishment of UMTA		■	■	■								
		Establishment of Agency for Planning, Introducing, Operating, and Expanding ITS		■	■	■								
Preparation of Upper Level Plan of ITS			■	■	■								To be continuously carried out after completion of 1st edition (*)	
Preparation of ITS Architecture				■	■								To be continuously carried out after completion of 1st edition (*)	
Preparation of ITS Implementation Plan				■	■	■							To be continuously carried out after completion of 1st edition (*)	
Preparation of Basic Environment for Quantitative Measurement on Traffic				■	■	■	■							
Preparation of Regional ITS Centres				■	■	■	■							
Integration and Expansion of ITS						■	■	■	■	■	■	■	■	To be continuously carried out
Capacity Building			■	■	■	■	■	■	■	■	■	■	■	To be continuously carried out
<b>Measures to Be Taken in Parallel</b>														
Improvement of Road Infrastructures			■	■	■	■	■	■	■	■	■	■	■	To be continuously carried out
Improvement of Public Transportation			■	■	■	■	■	■	■	■	■	■	■	To be continuously carried out
Improvement of Traffic Manners			■	■	■	■	■	■	■	■	■	■	■	To be continuously carried out

Note (\*): The above shown schedule is for completion of the 1st edition.

## (6) Required Measures

### 1) National Level

- **Reinforcement of Inter-Ministerial Framework**

The ITS Task Force shall be a core group for inter-ministerial collaboration. Thus, strengthening the functions, roles, capabilities and members of the ITS task shall be more accelerated.

- **Reinforcement of Collaboration amongst Industry, Government and Academia, and International Network**

Association of Intelligent Transport Systems Ltd. (ATIS), a representative of private sector, is expected to play roles in bridging amongst industry, government and academia in India. Thus, such collaborative framework shall be more reinforced at the core of the AITS.

- **Preparation of Upper Level Plan of ITS and National ITS Architecture**

The National ITS master plan with a long-term vision shall be prepared. It needs to be prepared in line with the related national strategies such as five-year plan, National Urban Transport Plan, National IT Strategies and etc.

- **Improvement of Accident Information Management and Nation-Wide Expansion**

The city of Chennai is preparing the accident database, supported by the World Bank. The city database is shared with the central government, traffic administrators, and road administrators, planning agencies, vehicle registration authorities and Indian Road Congress. This model shall be replicated to other cities for improving the traffic management efficiency.

- **Improvement of Vehicle Registration/Number Plate/Drivers' Licence Mechanism**

There are no resident registration and vehicle inspections which are available in Japan. On the other hand, the Indian government has begun considering the introduction of the personal ID card system and integration of the number plate across the country. Such measures shall be comprehensively taken to improve these related basic environment which are required for ITS.

- **Improvement of Road Management**

The preparations of road inventory database in Mumbai and Hyderabad are underway supported by the World Bank and JICA, respectively. Such role models shall be replicated to other cities to enable proper road management.

- **Preparation of Fund**

In the case of toll roads, the cost for installation, operation and maintenance can be covered by the revenue generated by toll collection. However in the case of the city roads, such revenue can not be expected. Thus, a special scheme for the funds needs to be elaborated at national level, considering such difficulties for assuring the financial resources for the city ITS.

- **Capacity Building**

The capacity building is one of the most important factors for sustainable ITS implementation. The attention shall be focused on the decision makers in view of the capacity building at the national level, particularly the members involved in ITS Task Force.



## 2) Regional Level

- **Acceleration of Establishment of UMTA**

The Unified Metropolitan Transport Authority (UMTA) was established in some cities and others are still in process. The purpose of UMTA is for coordination and high-level decision-making for urban transport in the major cities. Such authority holds significant importance for ITS, specifically considering multi-sectorial and interdisciplinary features of ITS.

- **Establishment of a Single Body for Planning, Introducing, Operating and Expanding ITS**

The above said UMTA is a coordination and decision making body. A single nodal agency is required and it shall be responsible consistently for planning, introduction, operation and expansion of ITS at regional level, considering a complex administrative structure in India.

- **Upper Level ITS Strategy/ITS Architectures at Regional Level**

The regional ITS strategies and ITS architectures shall be prepared under the framework of the National ITS master plan and ITS architectures.

- **Preparation of Basic Environment for Quantitative Measurement on Traffic**

As described before, a basic system environment which enables to utilise the quantitative road traffic measurement for generation of dynamic traffic information and reflecting on road/transport planning.

- **Establishment of Regional ITS Centre**

Various subsystems of ITS shall be deployed in future based on the regional ITS plan. It is thus necessary to prepare the regional ITS centre to aggregate and integrate these subsystems. It shall function as a centre for utilisation of collected data, taking measures for planning and evaluation for road and traffic improvement, responsible for expansion of ITS and assuring compliance with national level ITS strategies/policies in future.

- **Integration and Expansion of ITS**

The additional functions and subsystems shall be expanded at the core of the above regional ITS centre under the framework of the regional ITS strategy. The functions shall be gradually expanded in accordance with improvement of the road infrastructures, public transport and traffic manners.

- **Capacity Building**

The capacity building is imperative factor at the regional level as well. It involves quite broad range of fields for the capacity building. But it shall preferentially focus on strengthening the capabilities of the personnel of the planning authorities, traffic and road administrators. It is observed that the implementation of ITS including designing, installation and operation throughout the entire life cycle of ITS is largely dependant on the private sector in India. Therefore, know-how on ITS has not been accumulated in the government side. They shall be able to make proper judgement on ITS.

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## List of Abbreviations

Abbreviation	Description
AICTSL	Atal Indore City Transport Services Ltd
AITs	Association for Intelligent Transport Systems
AJL	Ahmedabad Janmarg Limited
AMC	Ahmedabad Municipal Corporation
APSRTC	Andhra Pradesh State Road Transport Corporation
ATC	Area Traffic Control Centre
AUDA	Ahmedabad Urban Development Authority
BBMP	Bruhat Bangalore Mahanagar Palike
BEST	Bombay Electric Supply and Transport Company
BMLTA	Bangalore Metropolitan Land Transport Authority
BMRDA	Bangalore Metropolitan Authority Development
BMTC	Bangalore Metropolitan Transport Corporation
BOT	Build Operate Transfer
BRICS	Brazil, Russia, India, China and South Africa
BRTS	Bus Rapid Transit System
BSNL	Bharat Sanchar Nigam Limited
B-TRAC	Bangalore - Traffic Improvement Project 2010 (name)
CCTV	Closed Circuit Television
C-DAC	Centre for Development of Advanced Computing
CDMA	Code Division Multiple Access System
CEPT	Centre for Environmental Planning and Technology
CGRAPS	Critical public surveillance, Garbage vehicle management, Red light violation, Area traffic control system, Passenger information system and Speed limit violation system
CMP	Comprehensive Mobility Plan
CUMTA	Chennai Unified Metropolitan Transport Authority
DeitY	Department of Electronics and Information Technology
DFC	Dedicated Freight Corridor
DIMTS	Delhi Integrated Multi Modal Transit System
DMIC	Delhi Mumbai Industrial Corridor
DMRC	Delhi Metro Rail Corporation
DND	Delhi-Noida-Direct
DoT	Department of Telecommunications
DPR	Detailed Project Report
DSRC	Dedicated Short Range Communication

<b>Abbreviation</b>	<b>Description</b>
DTC	Delhi Transport Corporation
EPE	Eastern Peripheral Expressway
ERP	Electronic Road Pricing
ETC	Electronic Toll Collection
GDP	Gross Domestic Product
GIFT	Gujarat International Finance Tec-City Company Limited
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communication
GUDA	Gandhinagar Urban Development Authority
GUDC	Gujarat Urban Development Company Ltd
HMDA	Hyderabad Metropolitan Development Authority
HSBC	Hongkong Shanghai Banking Corporation
HTMS	Highway Traffic Management System
HTRIMS	Hyderabad Traffic Management System
IDA	Indore Development Authority
IDFC	Infrastructure Development Financial Corporation
IIM	Indian Institute of Management
IISc	Indian Institute of Science
IIT	Indian Institute of Technology
IRR	Inner Ring Road
ISO	International Organisation for Standardisation
ITPB	International Tech Park Bangalore
ITS	Intelligent Transport System
IUT	Institute of Urban Transport of India
JICA	Japan International Cooperation Agency
JnNURM	Jawaharlal Nehru National Urban Renewal Mission
KMP	Kundli-Manesar-Palway
KSRTC	Karnataka State Road Transport Corporation
LED	Light Emitting Diode
MCGM	Greater Mumbai Municipal Corporation
MEGA	Metrolink Express for Gandhinagar & Ahmedabad
MMRDA	Mumbai Metropolitan Region Development Authority
MMTS	Multi Model Transport System
MoR	Ministry of Railway
MoRTH	Ministry of Road Transport and Highway
MoUD	Ministry of Urban Development



<b>Abbreviation</b>	<b>Description</b>
MRTS	Mass Rapid Transit System
MTC	Metropolitan Transport Corporation Chennai
MTNL	Mahanagar Telephone Nigam Limited
NCR	National Capital Region
NGO	Non Governmental Organisation
NH	National Highway
NHAI	National Highways Authority of India
NHDP	National Highways Development Project
NICE	Nandi Infrastructure Corridor Enterprises Ltd
NTT	Nippon Telegraph and Telephone Corporation
NUTP	National Urban Transport Policy
OBU	On Board Unit
ORR	Outer Ring Road
PMC	Pune Municipal Corporation
PMPML	Pune Mahanagar Parivahan Mahamandal Limited
R&D	Research and Development
RFID	Radio Frequency Identification Data
RMMS	Road Maintenance and Management System (Database)
RTA	Road Transport Authority
SAPI	Special Assistance for Project Implementation
SCATS	Sydney Coordinated Adaptive Traffic System
SCOOT	Split Cycle Offset Optimisation Technique
SEZ	Special Economic Zone
SH	State Highway
SIAM	Society for Indian Automobile Manufactures
SMS	Short Message Service
SPV	Special Purpose Vehicle
STPI	Software Technology Parks of India
TMS	Toll Management System
TOD	Transit Oriented Development
TRAI	Telecom Regulatory Authority of India
UMMTA	Unified Mumbai Metropolitan Transport Authority
UMTA	Unified Metropolitan Transport Authority
USA	United States of America
USD	United States Dollar
VIP	Very Important Person
VMS	Variable Message Sign

## **Chapter 1. Study Outline**

### **1-1 Study Name**

The study name is the Data Collection Survey on the Introduction of Intelligent Transport Systems to Urban Transportation in Major Cities in India.

### **1-2 Study Objective**

The objective of this study is to conduct a thorough fact-finding on ITS being implemented/planned and related traffic/transport issues. It is intended to identify, based on the fact-findings, the major issues and challenges of ITS and make appropriate recommendations for effective introduction to the various Indian cities, and successful and sustainable implementations.

### **1-3 Study Contents**

The study involved the extensive interviews with important stakeholders of ITS and transport sector across nine (9) cities in India. The related data/information as secondary means was further collected/obtained from the stakeholders, their portals, websites, magazines, journals and etc.

The issues which are common across the cities and peculiar to India were observed. The issues which particularly pertain to the individual cities were also found. Thus, they are summarised by i) national level, ii) regional level which are common across the cities and iii) city level. The recommended measures by national level and regional level are proposed based on the issues identified.

### **1-4 Study Items**

The study was conducted in perspective of 1) the current situation at the national level, 2) the current situation at each city level, and 3) other related matters, based on the above view point.

#### **(1) Conditions at the National Level**

- ITS related policies at the national level
- Stakeholders and their roles
- Status of ITS architecture and standards
- ITS market (in terms of population, growth rate, number of sales, and number of vehicles owned)

**(2) Conditions at Regional Level**

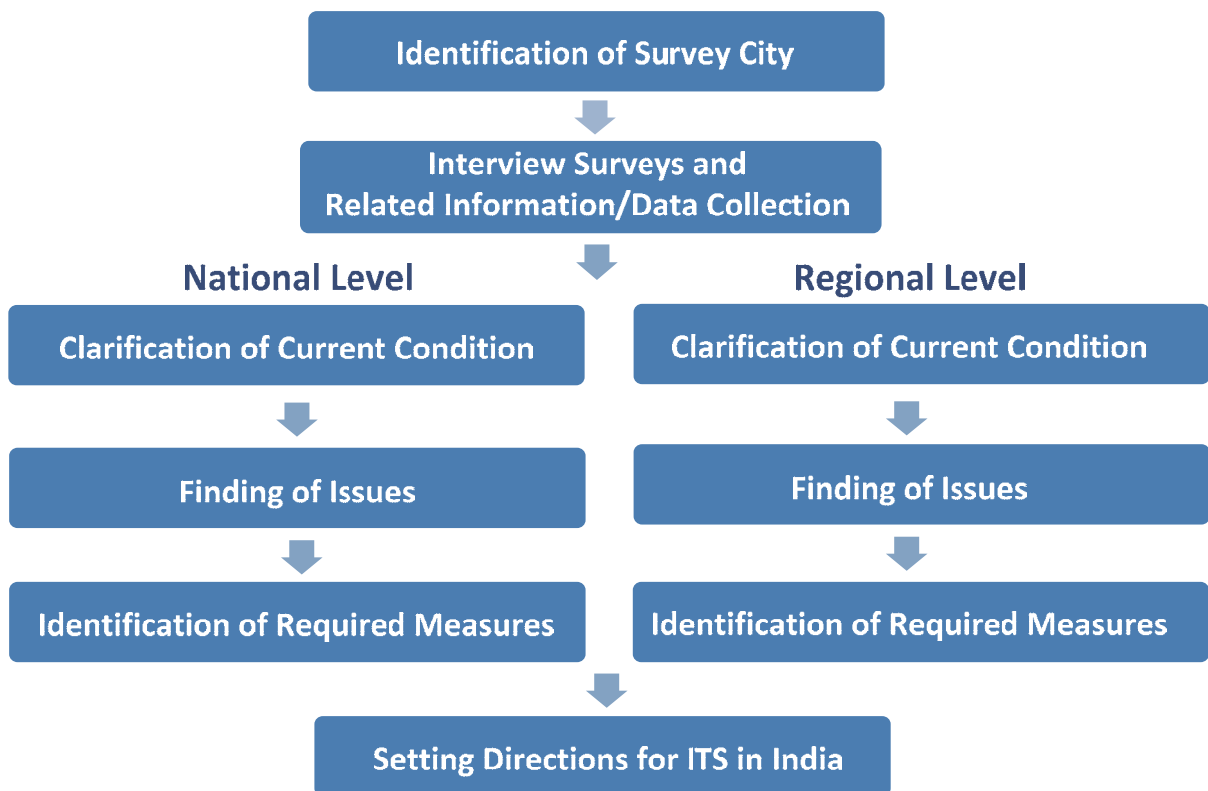
- Stakeholders and their roles
- Regional characteristics
- Current status and future plans of urban development
- Current status of road traffic and future plans
- Current status and future plans on public transport
- Existing ITS conditions and future plans

**(3) Other Items**

- Other donors' activities in ITS sector in India
- Major activities of private companies in ITS sector in India
- Major procurement methodologies

**1-5 Study Flow**

The study flow is depicted in the Figure below.



(Source: JICA Study Team, 2012)

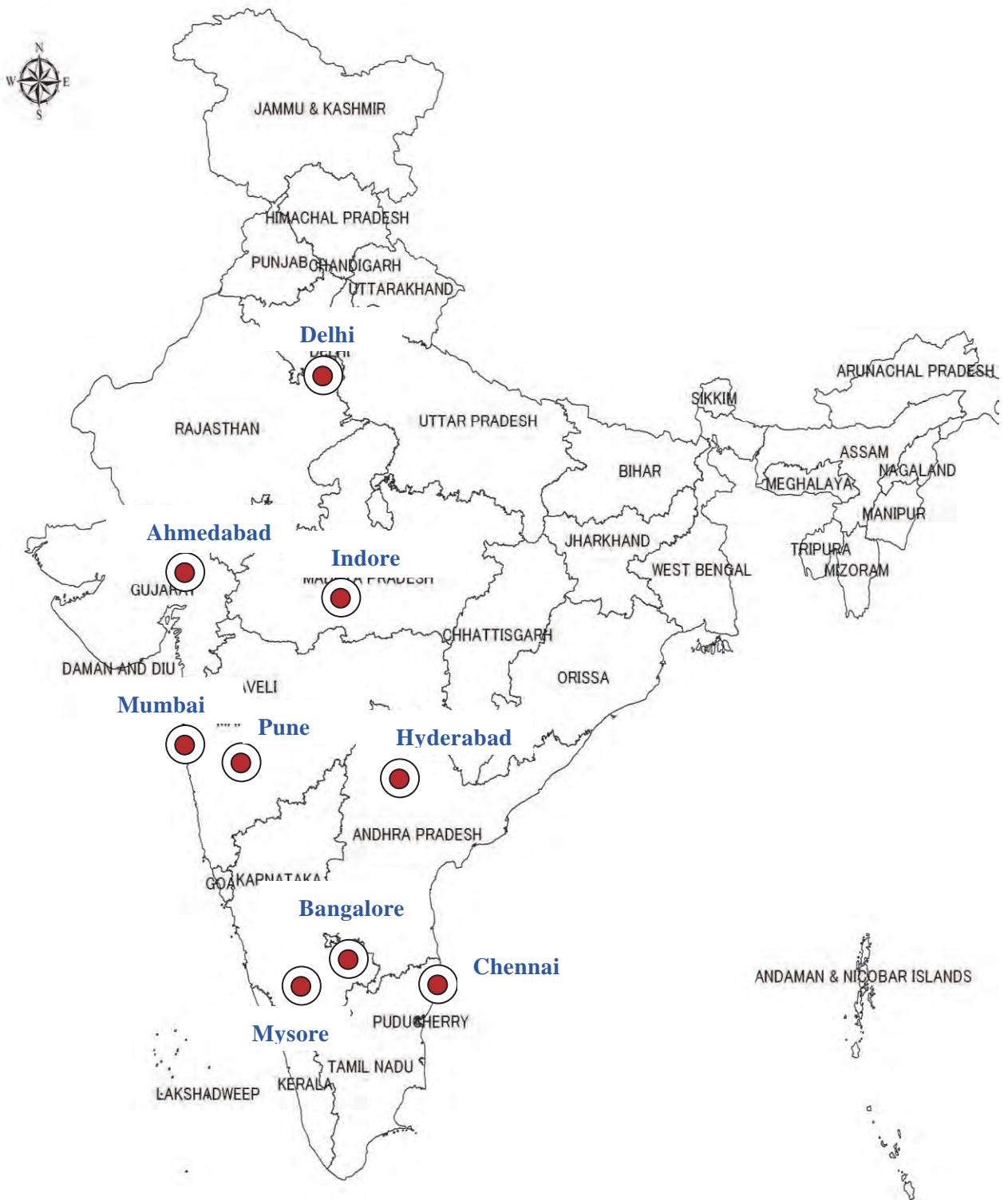
**Figure 1-1 Study Flow**

## **1-6 Studied Cities**

The following nine cities were covered by the study. They were selected due to the reason that the ITS facilities are already in place at certain level and some major ITS related projects are in progress.

1) Delhi, 2) Ahmedabad, 3) Hyderabad, 4) Bangalore, 5) Mysore, 6) Chennai, 7) Indore, 8) Mumbai, and 9) Pune

The next Figure shows the target cities.



(Source: JICA Study Team, 2012)

**Figure 1-2 Study Location Map of the Nine Cities**

## **1-7      Workshop**

A workshop was jointly organised by the Ministry of Urban Development (MoUD) and JICA in conclusion of the field study on ITS in nine (9) Indian cities. The purposes of the workshop are i) to share findings, observations and preliminary recommendations on various ITS initiatives from JICA Study Team, ii) to receive requirements as well as issues/difficulties facing from the representatives of Indian cities which were covered under the study, so that such inputs can be incorporated into further considerations of successful implementations of ITS in India.

The participants of the workshop includes the authorities from nine (9) Indian cities namely Delhi, Ahmedabad, Hyderabad, Bangalore, Mysore, Chennai, Indore, Mumbai and Pune, and the representatives from the agencies including National Highway Authority of India (NHAI), Delhi Integrated Multi Modal Transit System Ltd (DIMTS), Centre for Development of Advanced Computing (C-DAC), Delhi Metro Rail Corporation (DMRC), Association for Intelligent Transport Systems (AITS), Department of Electronics and Information Technology (DeitY), Delhi Development Authority (DDA), Society for Indian Automobile Manufacturers (SIAM), Chennai Metropolitan Development Authority (CMDA), Indian Institute of Technology Chennai (IIT Chennai), Bangalore Metro Rail Corporation Limited (BMRCL), etc.

## **Chapter 2. Current Conditions at National Level**

### **2-1 Overview of ITS in India**

Any high level strategies/plans of ITS which show long-term vision such as national ITS master plan have not been formulated in India. The inter-ministerial organisation framework, cross-sectorial collaborative structure involving government, academia and industry are critical for promotion of ITS in India. This framework is not sufficiently in place yet.

Under such condition, the individual agencies such as traffic administrators, road administrators, public transport agencies are independently preparing their ITS facilities in the region.

Nevertheless, the necessity and importance of preparation of ITS strategies/plans and reinforcement of the organisational structures are increasingly recognised by the national and regional stakeholders in India.

### **2-2 Outline of Related Policies at the National Level**

The related high level strategies/plans such as five (5) year plan and national urban transport plan touches on the ‘importance of utilising ITS technology’ to tackle the worsening urban traffic issues in recent years. However, the descriptions which appear on such high level strategies/plans have not been profoundly elaborated yet. The related policies at national level are summarised below.

#### **(1) Roles of the Central Government and State Government in Urban Transport**

As per the constitution of India, urban policies (land use, economic development, urban planning, urban development, urban transport infrastructure, housing, water supply maintenance, etc.) are under the jurisdiction of the state government. The national urban policy and related funding schemes are decided by the central government as part of its national five year plan.

#### **(2) Five Year Plan**

The five year plan is the highest strategy formulated every five year. It addresses the socio-economic issues of the country and sets out the financial goals and national strategies for economy, finance, urban development, transport, energy, industry, education, environment, and other wide-ranging fields.

### **(3) 11<sup>th</sup> Five Year Plan (FY2007-FY2011)**

The 11th Five Year Plan focuses on the issues in the sector of urban transportation. It stresses 1) more attention for pedestrian and bicycle traffic, 2) the need for introduction of a common card for public transport, 3) promotion of environmentally friendly transport, and 4) the importance of utilising ITS, of which items of 2) and 4) are described below.

The need for introduction of a common card:

- The common card does not exist in India yet,
- It is necessary to prepare a system which realises distribution of the revenue amongst the different operators,
- It shall be expanded to all cities.

The importance of utilising ITS technology:

- The ITS technology can resolve the traffic issues if they are properly integrated with the urban transport infrastructure,
- This aspect contributes to the improvement of safety as well.

### **(4) 12<sup>th</sup> Five Year Plan (FY2012-FY2016)**

The preparation of the 12<sup>th</sup> Five Year Plan is underway as of November in 2012. The Government of India constituted a working group to provide recommendations on urban transport for the plan. The major recommendations related to ITS are listed as follows:

#### **1) Prioritised Areas of ITS**

- To make it available real-time information using maps and GPS and traffic demand management utilising the real-time traffic information,
- To introduce congestion based road pricing utilising ITS technologies, and develop toll road collection systems,
- To implement quantitative traffic data collection, enhanced decision making support in urban transport planning and management through analysis of data, and promotion of automated control systems,
- To carry out traffic monitoring and traffic management, and integrate multimodal transport systems.



## **2) Prioritised Areas of Urban Transport**

- To strengthen the institutional framework of the urban transport sector,
- To reinforce capacity building of stakeholders,
- To improve road maintenance and sidewalks, and strengthen the development of last mile connectivity,
- To strengthen the development of city bus transport (in the cities of more than 200,000 population), and BRT (in the cities of more than one million population),
- To develop major road network and connect the missing links (in the cities of more than 200,000 population).

## **(5) National Urban Transport Policy (NUTP)**

The National Urban Transport Policy (NUTP) was launched in April 2006. It is the major national urban transport policy in India. It is a guideline for development/planning of urban transport. The following recommendations are made for the cities of more than 4 million population;

- To develop a plan of urban mass transport systems for the next 30 years,
- To promote urban transportation plan integrated with urban development plan,
- To strengthen development of public transport, non-motorised transport and parking facilities,
- To establish UMTA.

The NUTP highlights the enhancement of public transportation together with the introduction of ITS as well as public infrastructure and facilities.

All urban transport projects funded by JnNURM conform to the conditions stated on the NUTP.

## **(6) Jawaharlal Nehru National Urban Renewal Mission (JnNURM)**

### **1) Overview of JnNURM**

#### **(a) Outline of JnNURM**

The JnNURM scheme was launched in 2005 by the Prime Minister Manmohan Singh. It is the largest scheme by the central government with a budget of approximately 10 billion USD to support infrastructure development in the major cities of the country.

The outlines are;

- It includes seven metropolitan cities, 28 cities with populations of one million, and other major cities,
- It includes the slum improvement by supporting the urban poor.

The state government is required to prepare the City Development Plan (CDP) or Comprehensive Mobility Plan (CMP) or Detailed Project Report (DPR). These reports need to be ap-

hensive Mobility Plan (CMP) or Detailed Project Report (DPR). These reports need to be approved by the Ministry of Urban Development (MoUD), in order to receive the financial support from the central government under JnNURM.

**(b) Outline of Implementation Status of JnNURM**

In the sector of urban infrastructure, the activities such as maintenance and development of flyovers/roads, parking spaces, urban transportation, drainage, water supply facilities, etc., were carried out. The BRTS were developed as part of urban transport sector. The Ahmedabad BRT was prepared under this scheme in 2009 and it is widely known as one of the most successful BRTS in India. Upon success of the Ahmedabad BRT, other major cities in the country also focus on the development of the BRTS. There are many cases that the plans prepared by the cities failed in approval of the MoUD due to insufficient feasibilities.

So far, the urban transport sector accounts for about 25% of the total JnNURM funding, whilst BRT accounts for about 33%.

It is observed by the study that the development of the BRTS is disproportionately focused in the sector of the urban transport.

The overview of the status of JnNURM is shown in Table below.

**Table 2-1 JnNURM Status Summary (as of Sep 2012)**

	<b>Sector Name</b>	<b>Approved Cost (USD million)</b>	<b>Total Cost (%)</b>
1	Roads/Flyovers	1,593	13.58%
2	Parking Lots	163	1.39%
3	Mass Rapid Transit	986	8.40%
4	Other Urban Transport	151	1.28%
5	Urban Renewal	92	0.78%
6	Drainage/Storm Water	1,603	13.67%
7	Water Supply	3,874	33.02%
8	Sewerage	2,833	24.15%
9	Solid Waste	373	3.18%
10	Development of Heritage Area	44	0.37%
11	Water Preservation	21	0.18%
	<b>Total</b>	<b>11,732</b>	

(Source: Prepared by JICA Study Team based on JnNURM Website Information)

**(c) JnNURM (Second Phase)**

JnNURM in the second phase is under consideration by the MoUD. According to the news reports in June 2012, the government will launch USD 40 billion budget for the second phase of JnNURM. It is expected that the JnNURM in the second phase will more focus on the sector of road and transport development.

**(7) Indo-Japan Working Group on Urban Development**

In pursuance of the Joint Statement towards Japan–India Strategic and Global Partnership announced by the Prime Ministers of Japan and India in December, 2006, a Memorandum of Understanding (MOU) between India and Japan on cooperation in the field of Urban Development was signed in May 2007.

The Working Group meets once a year and is co-chaired by the Secretary, Ministry of Urban Development, Government of India and Vice-Minister for Engineering Affairs, Ministry of Land Infrastructure and Transport, Government of Japan. Separate Sub-Working Groups on Water Environment, Urban Development and Urban Transport have been constituted. The Sub-Working Group on Urban Transport deals with issues related to Urban Transport Planning, Development of Public Urban Transport and Intelligent Transport System.

So far six Working Group meetings have been held. Besides, workshops focusing on ITS have been organised. Based on the discussions, following areas on Urban Transport were identified for exploring further cooperation.

- Comprehensive mobility planning and management using ITS
- ITS enabled Modern city bus service and traffic information management centres
- Capacity building in Urban transport in areas such as ITS, Rail based transit systems, multi modal integration

Besides the above, the Government of India has shown keen interest on extending cooperation for planning and implementing ITS in Indian cities. The Government of Japan has also responded positively and have recommended identification of appropriate urban areas where such cooperation could be extended.

## **(8) Summary of Current Condition at National Level**

The current situations at the national level in India are summarised as follows:

- Any high level strategies/plans of ITS which show long-term vision such as national ITS master plan have not been prepared in India yet.
- In recent years, the high level national plans such as the five year plan and NUTP mention the importance of utilising ITS technologies, but not sufficiently elaborated yet.
- The 12th Five Year Plan is currently being prepared and important policy initiatives are included for ITS implementation in the country.
- The decision making mechanism based on real-time traffic information, and the development of accounting systems, quantitative data collection and traffic are focused in the 12<sup>th</sup> Five Year Plan.
- The organisational framework, capacity building of stakeholders, and improvement of public transport and sidewalks are prioritised.
- The development of BRT under JnNURM is the major focus of the urban transport development.
- Indo-Japan Working Group on Urban Development has been setup under the framework of Japan-India Strategic and Global Partnership. The Sub-Working Group on Urban Transport deals with issues related to ITS. In such circumstance, extension of cooperation for planning and implementing ITS in Indian cities has been increasingly keen interest of India and Japan in recent years.

## 2-3 Related Agency (National Level)

### (1) Stakeholders

The inter-ministerial organisation framework and cross-sectorial collaborative structure involving government, academia and industries are critical for promotion of ITS in the country. However, such organisational frameworks are not sufficiently in place yet at both national and regional level in India.

The Ministry of Urban Development, mainly involved in the urban ITS, and the National Highways Authority of India (NHAI) under the Ministry of Road Transport and Highways (MoRTH) are closely related with ITS at the national level.

The Centre for Development of Advanced Computing (C-DAC), a government-affiliated research institute, under the Ministry of Science and Technology carries out research and development of ITS technologies which suites for the Indian location conditions. Other academic and research institutions such as the Indian Institute of Technology (IIT) are also conducting ITS related researches. There are 16 universities across India and among them; the institutions such as IIT Madras, IIT Mumbai and IIT Delhi carry out the ITS researches for probe data and image processing.

Association for Intelligent Transport Systems (AITS) is expected to play a role, representing the private sectors, for bridging amongst government, academia and industry, and nodal point of the international activities for ITS.

The Table below shows the major stakeholders at national level.

**Table 2-2 The Main Related Agencies**

<b>Central Government</b>	
Ministry of Urban Development (MoUD)	In charge of urban development and urban transportation at the national level with focus on urban ITS.
Institute of Urban Transport of India (IUT)	Under the MoUD, advisory and coordinative roles for urban transport related issues.
Ministry of Road Transport and Highways (MoRTH)	In charge of road and transportation sector (national highways of inter-city and within city)
National Highways Authority of India (NHAI)	Under MoRTH, in charge of construction and management of national highways.
Department of Telecommunications (DoT)	Under the Ministry of Communications, in charge of policies on telecommunications (wired and wireless communication).
Department of Electronics and Information Technology	Under the Ministry of Science and Technology, in charge of research and development of information technology (IT).
Ministry of Railways (MoR)	In charge of inter-city railways in India
Centre for Railway Information Systems	Under the MoR, in charge of communication systems and computerisation of railways.

<b>Government Research Institutes</b>	
Centre for Development of Advanced Computing (C-DAC)	Research and development in the area of information technology, including ITS.
<b>Academic and Research Institutes</b>	
Indian Institute of Technology (IIT) - Delhi	Research and development for ITS, probe related technologies in particular
Indian Institute of Technology (IIT) - Mumbai	Research and development for ITS, image processing technologies in particular
Indian Institute of Technology (IIT) - Chennai	Research and development for ITS, image processing, traffic volume measurement in particular
Indian Institute of Science (IISc) - Bangalore	The public educational institute in the area of science and technology. Research and development for ITS, enforcement, traffic signal control, road-side sensors and trip planner in particular

(Source: Prepared by JICA Study Team based on Interview and Materials)

## (2) ITS Task Force

The ITS Task Force was established in September 2007 led by MoUD. It is intended to function as a central role for inter-ministerial and cross-sectorial collaboration. The task force is chaired by the secretary of MoUD and consists of the core members of the related ministries and agencies. The terms of reference of the Task Force are to identify goals for India, promote technologies and systems for safety, sustainability and security. It also setup a technical committee to work on the following areas:

- National ITS Framework for India
- ITS Standard Regulatory Authority (ISRA)
- ITS Infrastructure (Mapping, Galileo, ICT & Power)
- Funding & Evaluation
- ITS Education and Training Promotion
- Joint Research and Technology Sharing Projects with International Counterparts
- Promote Close Partnerships – Inter-Sectorial and Multi-Sectorial
- Make Business Plans and Marketing Technology
- Provide Continuous Assessment of Outcomes

(Source: Notice for ITS Task Force Formulation, MoUD, 2007)

It is mostly expected that the ITS Task Force will become a key organisational structure for inter-ministerial and cross-sectorial collaboration for promotion of ITS in India.

## 2-4 Current Conditions of ITS Architecture and Standardisation

The ITS architecture has not yet been prepared at both national and regional levels in the country. However, the importance of ITS architecture is widely recognised and a technical committee was established consisting of industry, government and academic agencies and Non Governmental Organisation (NGO) organizations led by MoUD. The first meeting was held on October 3, 2012. The members from the C-DAC and JICA ITS expert were invited for the meeting. The members of the technical committee are shown in Table below.

**Table 2-3 ITS Architecture Technical Committee Members**

<b>Position</b>	<b>Department</b>
Joint Secretary	Ministry of Road Transport and Highways (MoRTH)
Joint Secretary	Department of Electronics and IT, Ministry of Communications and IT
Joint Commissioner	Delhi Traffic Police
General Manager	Mahanagar Telephone Nigam Limited (MTNL)
Member (Technical)	National Highways Authority of India (NHAI)
Senior Director	Cisco Systems Inc.
President	Association of Intelligent Transport Systems (AITS)
Adviser	Society for Indian Automobile Manufactures (SIAM)
Special Officer	Ministry of Urban Development (MoUD)

(Source: ITS Architecture Sub Committee Meeting held on 03-10-2012, MoUD)

## 2-5 ITS Market Prospect

### (1) Population Comparison

The population of India as of 2012 is approximately 1.2 billion with a growth rate of 17.6% in the last ten years, according to the Ministry of Family Welfare, Government of India. By 2030, the population in India is expected to outnumber China. There are 53 cities of more than one million urban populations in India. The population in Mumbai and Delhi exceeds 15 million. The cities that have more than one million populations are listed in the next Table.

**Table 2-4 Million Population Cities (2011)**

	City	Population		City	Population		City	Population
1	Greater Mumbai	18,414,288	19	Kozhikode	2,030,519	37	Srinagar	1,273,312
2	Delhi	16,314,838	20	Bhopal	1,883,381	38	Jabalpur	1,267,564
3	Kolkata	14,112,536	21	Thrissur	1,854,783	39	Asansol	1,243,008
4	Chennai	8,696,010	22	Vadodara	1,817,191	40	Vasai	1,221,233
5	Bangalore	8,499,399	23	Agra	1,746,467	41	Allahabad	1,216,719
6	Hyderabad	7,749,334	24	Visakhapatnam	1,730,320	42	Dhanbad	1,195,298
7	Ahmadabad	6,352,254	25	Malappuram	1,698,645	43	Aurangabad	1,189,376
8	Pune	5,049,968	26	Thiruvananthapuram	1,687,406	44	Amritsar	1,183,705
9	Surat	4,585,367	27	Kannur	1,642,892	45	Jodhpur	1,137,815
10	Jaipur	3,073,350	28	Ludhiana	1,613,878	46	Ranchi	1,126,741
11	Kanpur	2,920,067	29	Nashik	1,562,769	47	Raipur	1,122,555
12	Lucknow	2,901,474	30	Vijayawada	1,491,202	48	Kollam	1,110,005
13	Nagpur	2,497,777	31	Madurai	1,462,420	49	Gwalior	1,101,981
14	Ghaziabad	2,358,525	32	Varanasi	1,435,113	50	Durg-Bhilainagar	1,064,077
15	Indore	2,167,447	33	Meerut	1,424,908	51	Chandigarh	1,025,682
16	Coimbatore	2,151,466	34	Faridabad	1,404,653	52	Tiruchirappalli	1,021,717
17	Kochi	2,117,990	35	Rajkot	1,390,933	53	Kota	1,001,365
18	Patna	2,046,652	36	Jamshedpur	1,337,131			

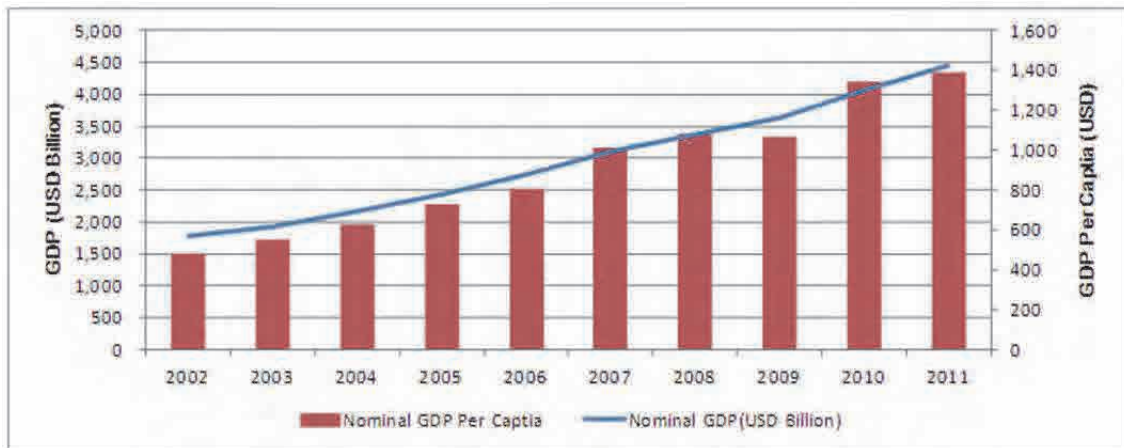
(\* Shaded cities: Cities covered by the study)

(Source: Prepared by JICA Study Team based on Census India Website Information, 2011)



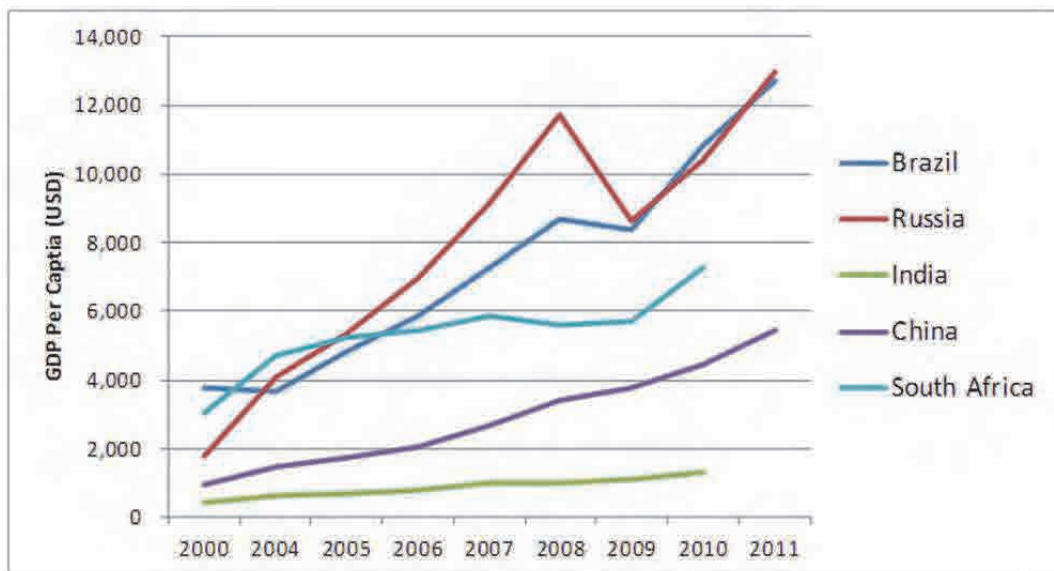
## (2) GDP Growth Ratio

India is one of the BRICS countries and has the highest economic growth rate next to China. Despite the slowdown of the global economy and variation in growth rates, India maintained an annual growth rate of about 10.8% over the last decade. It is estimated that the population of India will reach 1.6 billion in 2050. It is expected that the GDP of India will surpass that of Japan and will become the world's third largest economy behind China and USA by 2050. On the other hand, the per capita income is the lowest amongst the BRICS countries. There is a huge gap between the rich and poor. Whereas many of the middle class population are capable for purchasing the private cars, the lower income class population include very poor people whose daily income is less than one dollar.



(Source: Prepared by JICA Study Team based on BRICS Report, 2011)

**Figure 2-1 Growth of Nominal GDP and GDP per Capita**

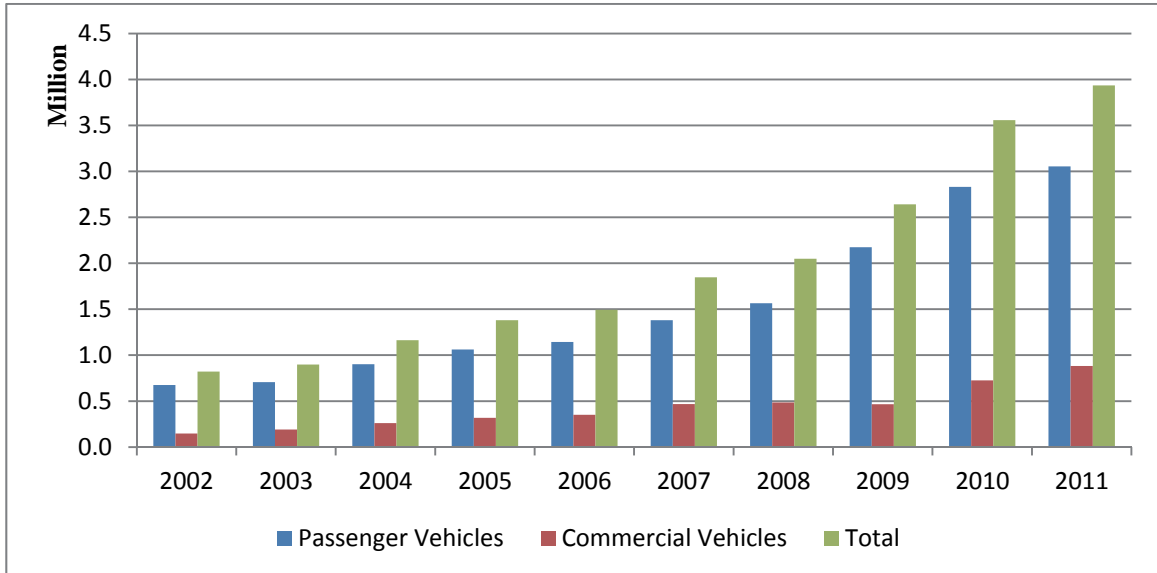


(Source: Prepared by JICA Study Team based on BRICS Report, 2011)

**Figure 2-2 Growth of GDP per Capita in BRICS Countries**

### (3) Growth of the Number of Registered Vehicles and Sales of Automobiles

In recent years, there is huge growth in the motor vehicle population in the country. The four-wheeler vehicle population increased from ten million units in 2003 to 20 million units in 2010. The number of registered motor vehicles was increased by approximately ten million units in seven years. The annual automobile sales grew from 800,000 in 2002 to 4 million in 2011, recording a fivefold increase in the last ten years.



(Source: Prepared by JICA Study Team based on SIAM Report, 2011)

**Figure 2-3 Growth of Sales of Four Wheelers in India**

## Chapter 3. Current Conditions at Regional Level

### 3-1 Progress of UMTA Set Up

The Unified Metropolitan Transport Authority, UMTA, is a high level coordinating body responsible for major decisions for urban transport in the city. The NUTP policy encourages setting up UMTA in cities with a million-plus population. The UMTA is an important structure in the urban transport sector.

A number of different bodies are also involved in planning, developing and operating ITS. Thus, the UMTA must be regarded as a critical body in view point of ITS as well.

The status of UMTA establishment in the cities is as shown in the Table below.

**Table 3-1 Status of UMTA in Cities**

City	Status	Remarks
Delhi	—	Under proposal UMTA is proposed to establish as the Delhi Urban Mass Transit Authority
Ahmedabad	—	Under consideration
Hyderabad	Established	Established in 2008
Bangalore	Established	Established in 2007 (Bangalore Metropolitan Land Transport Authority: BMLTA)
Mysore	—	Under consideration to include Mysore under the jurisdiction of BMLTA (Bangalore)
Chennai	Established	Established in 2012 (Chennai Unified Metropolitan Transport Authority: CUMTA)
Indore	—	Not planned
Mumbai	Established	Established in 2008 (Unified Mumbai Metropolitan Transport Authority: UMMTA)
Pune	—	Not planned

(Source: Prepared by JICA Study Team based on Interview and Materials)

### 3-2 Stakeholders in Cities

The stakeholders in the cities are listed on the attachment, 'Stakeholders List', categorised by i) planning agency, ii) road administrator, iii) traffic administrator, iv) public transport operators, and v) others.

### **3-3 Current Conditions at Regional Level**

#### **3-3-1 Overview**

Similar to other developing countries, India is facing the issues of inadequate basic road traffic infrastructure and traffic discipline. ITS is a software measure, of which effect can be expected under certain maturity of infrastructures and traffic discipline.

For example, it is difficult to correctly measure the traffic volume by vehicle type using the road-side sensors in the heterogeneous traffic. It is also challenging to divert the traffic by providing the alternative route information under the condition where the physical alternative routes do not substantially exist in the saturated road network in the city. The effect of the ITS may be limited under such current conditions in India.

#### **3-3-2 Road Infrastructure Condition**

It was observed that there are many factors to cause traffic congestion and accidents in the cities. The major observations are summarised as follows:

- The capacity of urban roads almost reached the saturated level due to insufficient road infrastructures.
- The two-wheelers hold the highest proportion of the traffic, followed by the three-wheelers. The proportion together with the two and three wheelers accounts approximately 70% to 80%.
- The distance between intersections is generally long and there are many roundabouts. In many cases, the traffic signals are installed on the roundabouts without re-construction of the structure of the intersection.
- There are many cases that the vehicles take u-turns at the locations other than the designated u-turn points, affecting the traffic flow. On the other hand, the number of the u-turn points are generally insufficient.
- The number of the parking is not sufficient in the city in general. It obligates the cars to park on the roads. The multi-level parking facilities are rare.
- There are a number of flood-prone areas in the city during the rainy season. The drainage system is generally obsolete.
- The pedestrian facilities such as sidewalks, zebra-crossings, pedestrian signals are scarce.

### 3-3-3 Traffic Manner

It can be said that India is, so called, a ‘vehicle-prioritised society’. The spaces for the pedestrians are not adequately in place in the cities except the limited areas in Delhi and Mumbai. The typical examples are extremely narrow sections and frequently missing sections of the footpaths along the road, a number of the obstacles standing in the middle of the sidewalk areas, unacceptably insufficient number of the pedestrian crossings, skywalks and pelican-crossings. The pedestrians are consequently forced to walk on the areas of the carriageway. Thus in India, the spaces for the vehicles and people are not clearly demarcated in the city, and the walking spaces are not practically functioning.

The typical road conditions in Indian cities are shown by the pictures below.



(Source: JICA Study Team, 2012)

**Figure 3-1 Typical Road Traffic Conditions**

### 3-3-4 Public Transport Overview

The public transport in urban areas is insufficient. The average utilisation rate of public transport in the eight cities, except Mumbai, is less than or equal to 40%. The utilisation of public transport in Mumbai is exceptionally high at approximately 90%. The reason is that the rail network was developed during the pre-independence period and is properly functioning.

The urban mass transport systems such as metro, BRTS, monorails are increasingly developed in the major cities in India. For example, the metros in Delhi and Bangalore are in operation. The BRTS in Delhi, Ahmedabad and Pune are in public service. These are planned in other cities as well. But such urban mass transport systems are still in progress of development. Therefore, the local city buses and three-wheeler auto rickshaws are still major transport means for public in the cities.

The modern equipment is used for BRTS and metro because they were recently developed. On the other hand, the vehicles and equipment of the public buses and local/inter-city trains are generally obsolete.

The contactless smart card payment systems are available in some of public transportations such as metro, BRTS and city buses. However, the common card payment system which can be used across different mode of traffic is not in place yet in India. But the introductions of such common payment system are under consideration in many cities. The pilot project for the common card is underway in Delhi.

Overview of the public transport in India is shown in the Figures below.



Figure 3-2 Public Transport in India



(Source: JICA Study Team, 2012)

**Figure 3-3 Metro (Delhi)**



**Figure 3-4 Victoria Station (Mumbai)**



**Figure 3-5 People Crossing Railway Line (Hyderabad)**



(Source: JICA Study Team, 2012)

**Figure 3-6 BRT (Ahmedabad)**





Figure 3-7 Inter City Rail (Chennai)



Figure 3-8 Typical City Bus (Chennai)



Figure 3-9 Typical City Buses (Pune)



Figure 3-10 Bus Stop (Pune)



(Source: JICA Study Team, 2012)  
Figure 3-11 Bus Stop (Delhi)



**Figure 3-12 Bus Terminal (Hyderabad)**



**Figure 3-13 Typical Taxi (Mumbai)**



**Figure 3-14 Typical City Bus (Hyderabad)**



**Figure 3-15 Three-Wheeler Auto Rickshaw (Indore)**



**Figure 3-16 Three-Wheeler Auto Rickshaw (Pune)**

(Source: JICA Study Team, 2012)

The current status of urban mass transport is summarised in the Table below.

**Table 3-1 Status of Urban Mass Transport in the Cities**

City	Metro	Monorail	BRTS	City Bus	Public Transport Usage Ratio
Delhi	Delhi Metro (Operated: 7 Lines-190km; Planned: 140km); Rapid Metro (Under Construction: 5.1 km)	Under Consideration: 3 Lines (47.8km)	Operated: 1 Line (14.5km); Under Consideration: 106.5km	5,667 Buses (773 Routes)	43%
Ahmedabad	Planned: 5 Lines (76km)	Under Consideration: 30km	Operated: 5 Lines (45km); Planned: 80km	1,100 Buses (212 Routes)	24%
Hyderabad	Under Construction: 3 Lines (72km)	Not Planned	Not Planned	3,872 Buses (850 Routes)	50%
Bangalore	Operated: 1 Line (6.7km); Under Construction: 2 Lines (35.6km); Planned: 2 Lines (72km)	Under Consideration: 60km	Not Planned	7,000 Buses (300 Routes)	55%
Mysore	Not Planned	Not Planned	Not Planned	500 Buses (100Routes)	45%
Chennai	Under Construction: 2 Lines (45km)	Under Consideration: 110km	Not Planned	3497 Buses (729 Routes)	50%
Indore	Not Planned	Not Planned	Operated: 1 Line (11.6km) Under Consideration: 7 Lines (109km)	119 Buses (50 Routes)	22%
Mumbai	Under Construction: 2 Lines (43km); Planned: 7 Lines (103km)	Under Construction: 1 Line (20km) Planned: 115km	Not Planned	4000 Buses (700 Routes)	90%
Pune	Planned: 2 Lines (31km)	Not Planned	Operated: 1 Line (15.5km); Under Consideration: 5 Lines (112km)	1825 Buses (369 Routes)	45%

(Under Consideration: Not Approved by Government; Planned: Approved by State and Central Government)

(Source: Prepared by JICA Study Team based on Interview and Materials)

### **3-3-5 Current Condition of ITS Facilities**

Some ITS facilities exist in the nine cities. The existing ITS facilities in India have similarities. They are generally consisted by the following components;

- Traffic management system consisted by centre, CCTV and signals
- Enforcement systems mainly for traffic signal violations and over speed
- Bus, BRT operation/monitoring system
- Metro operation/monitoring system
- Taxi operation/monitoring system

#### **(1) Responsible Agencies and Operations in General**

Generally in India, the traffic management systems and enforcement systems are procured by the city government. They are then handed over to the traffic police for their operations after installation. The operations and maintenance are usually outsourced to private companies.

The bus services are generally provided by the government bus agencies in India. The BRTS is generally managed by a Special Purpose Vehicle (SPV) under the city government. This agency procures the system and private companies operate and maintain, being outsourced by SPV.

The metro rail is managed by SPV under the state government.

The taxi services are generally provided by private taxi companies in India. Major private taxi companies provide their services across India. As exceptional cases, the state government of Karnataka and the city government of Indore provide taxi services.

#### **(2) Financial Outlook**

The financial outlook on system development and operations significantly differs by city. For example, it is relatively easier for the commercial cities, such as Mumbai and Bangalore, where a certain amount of tax is available to assure the required budget. Consequently, the systems are relatively well maintained. The requirement of the city government for the systems tends to be more strongly reflected in these cities.

On the other hand, it is more difficult to assure the required budget for the local cities such as Pune and Mysore. Therefore these cities are more dependent on the central government. Consequently, the demands or requirements of the central government tend to be more strongly reflected.

As interest exceptional case, the initial cost of the traffic signals was entirely covered by a private company in Indore. The private company is in charge for operation, under the traffic police, and they recover the initial cost and maintenance cost by the revenue of the advertisement. The advertisement is hanged on the poles of the traffic signals in the city.

The preparation of traffic centre is underway in Indore. The initial cost for the centre was provided by social organisations on charity bases. The basic concept for this is that such facilities as the centres and associated equipment are social asset because the benefit for the public

can be expected by improving traffic controls by these facilities.

The examples of the advertisement hanged on the poles in Indore are shown in the Figure below.



(Source: JICA Study Team, 2012)

**Figure 3-17 Traffic Signal with Advertisement (Indore)**

### **(3) Quantitative Traffic Data Measurement**

The traffic management is almost solely dependant on CCTV monitoring, and the facilities/systems for quantitative measurement on traffic are not in place in India yet. Thus, the ITS is not utilised for planning/evaluation of road infrastructure improvement and traffic measures. It is, furthermore, observed that many of the personnel in charge/involved in traffic management adhere an idea that the CCTV monitoring is all about the traffic management. The factors of technical challenge for quantitative measurement on traffic in India are;

- Mixed traffic, mainly composed of two-wheelers and three-wheelers,
- Insufficient traffic disciplines such as driving in opposite direction, lane braking and etc.

### **(4) Traffic Control Centre**

The cities where the traffic control centres are prepared at a certain level include i) Delhi, ii) Mumbai, iii) Bangalore, and iv) Pune.

In Delhi, the traffic control centre is managed by Delhi Integrated Multi Modal Transport Systems Ltd (DIMTS), a joint venture of the Government of the National Capital Territory of Delhi and Infrastructure Development Financial Corporation (IDFC). The function of the DIMTS now is operation of the BRT including monitoring traffic by CCTV and signal control along the BRTS corridors. But the concept for the DIMTS is a single unit to function as a centre of ITS in Delhi for planning, operating and expanding the subsystems in future. Whereas the DIMTS operates well established centre, the traffic police in Delhi do not have sufficient facili-

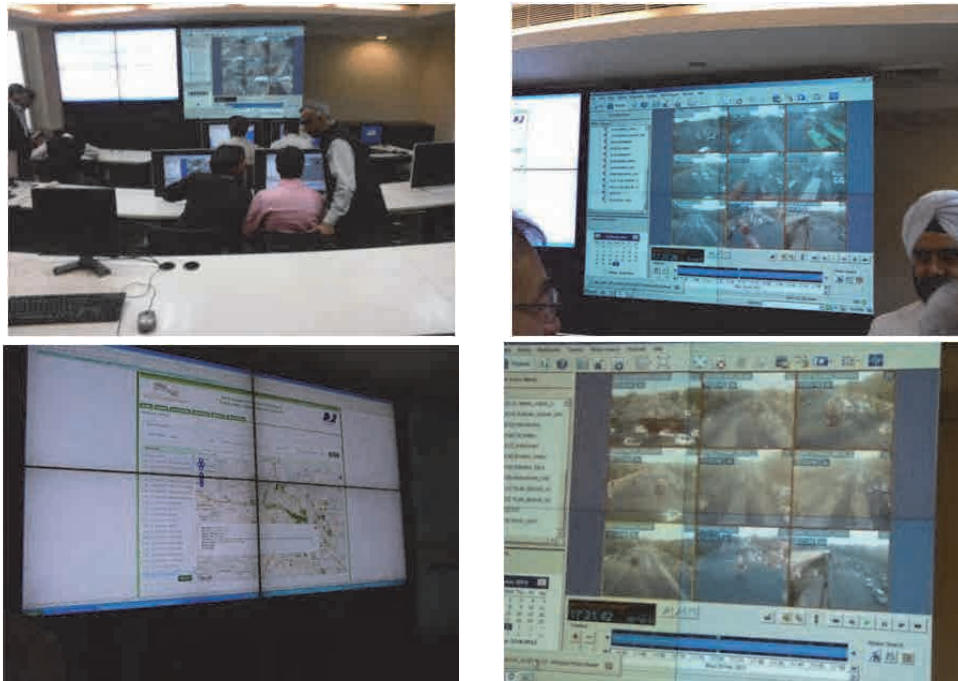
ties including the traffic control centre. The development of the traffic control centre of the traffic police is under planning.

In Mumbai, the traffic control centre and facility monitoring centre are operated by the traffic police and the Mumbai city government, respectively. Their centres and facilities are well established, and the coordination between the traffic police and the Mumbai city government are impressively made.

The traffic control centre in Bangalore is called 'B-TRAC'. It is operated by the traffic police. Their centre is reputed as one of the best practices in India.

In Pune, the control centre is managed by the Pune city government. The traffic police do not have their own control centre. In Hyderabad, the traffic control centre is in place but it is not prepared as satisfactorily as in the cases like Mumbai and Bangalore.

The basic components of these centres generally consist of CCTV monitoring, enforcement subsystems such as for traffic signal violations and over speed, and traffic signal control at limited sections.

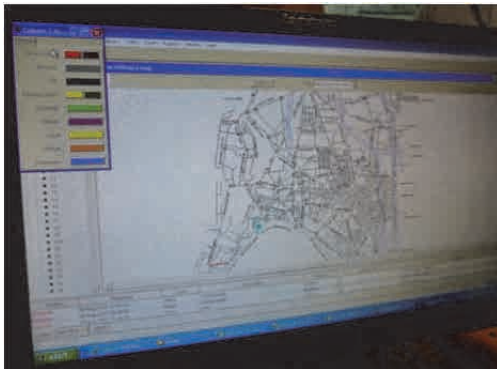


**Figure 3-18 DIMTS Control Centre (Delhi)**



(Source: JICA Study Team, 2012)

**Figure 3-19 Traffic Control Centre (Mumbai: Traffic Police)**

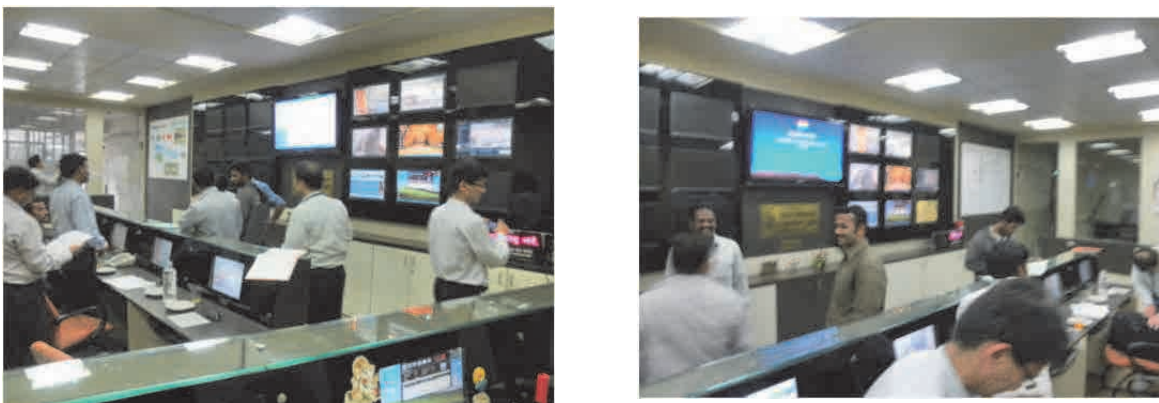


(Source: JICA Study Team, 2012)

**Figure 3-20 Facility Monitoring Centre (Mumbai: City Government)**



Figure 3-21 Traffic Control Centre B-TRAC (Bangalore: Traffic Police)



(Source: JICA Study Team, 2012)

Figure 3-22 Traffic Control Centre (Pune)

#### (5) Road Traffic Information Provision: Static Message on VMS

Some variable message sign boards (VMS) are placed in major cities such as Delhi, Mumbai, and Bangalore. However, the provided information is limited to static messages such as warnings on speed limit and wearing of helmets. The dynamic road and traffic information such as expected travel time, congestion level and route guidance is not available yet in India. The examples of the VMS displaying the static messages are shown in the Figures below.





**Figure 3-23 Stop Line Warning (Mumbai)**



**Figure 3-24 Over speed Warning (Mumbai)**



**Figure 3-25 Colour Shield Warning (Bangalore)**

(Source: JICA Study Team, 2012)

**(6) Road Traffic Information Provision: SMS, Website and Others**

The road and traffic information is generally provided via media technologies such as SMS, e-mail, radio, and so on. The provided information includes road closures at major sections or intersections due to VIP movement and festivals, major traffic hazards, etc. These are based on the reports by police staff at site. In Hyderabad, SMS is available on the website of traffic police, if registered. The interesting case is that the traffic information is announced by the speakers installed at the major junctions in Indore, as shown below.



**Figure 3-26 Speaker (Indore)**



**Figure 3-27 Speaker at the Junction (Indore)**

(Source: JICA Study Team, 2012)

**(7) Road Traffic Information Provision: Bus Operation Information**

The systems for monitoring and operations of buses equipped with GPS are prepared in the cities, except Hyderabad. The information on the arrival time and operation status of public buses is provided on the information boards installed at the bus stops in Indore, Chennai, Mumbai, and Delhi. Such information is also available at bus stops along the BRT corridor in Delhi, Ahmedabad, and Pune.



**Figure 3-28 Message at Bus Stop (Indore)**



**Figure 3-29 Message at Bus Stop (Indore)**



**Figure 3-30 City Bus Operations Monitoring Room (Indore)**



**Figure 3-31 BRT Bus Stop (Pune)**



**Figure 3-32 GPS Unit (Indore)**



**Figure 3-33 Information Board (Chennai)**

(Source: JICA Study Team, 2012)

## (8) Road Management

The basic road information is not sufficiently prepared and properly managed in the cities. In general, the city government is responsible for construction and maintenance of the general roads in the city, the National Highway Authority of India is for construction of the national road in the city, the state government is for maintenance of the national road in the city and construction and maintenance of the state road and the planning agency for road network planning. The general observation found that the road inventory and drawing of the roads in the city are not sufficiently available and managed by any of these agencies. Consequently, the proper road management is not adequately carried out. Moreover, the importance of such road management is not well recognised by the majority of the responsible personnel/agencies.

Exceptionally, such importance is greatly understood by the road administrator of Mumbai city. The preparation of a road inventory database which covers almost all arterial roads in Mumbai city including the associated facility information by road section is underway, supported by the World Bank. The database is called the 'Road Maintenance and Management System' (RMMS). Such system for the road management has not been prepared yet in other cities in India.

## **(9) Enforcement System and Vehicle Registration Database**

The enforcement systems are available in almost all studied cities. They include enforcement on i) traffic signal violations, and ii) over speed violations. The number plates of the violated vehicles are captured by CCTV cameras installed on the roadside. The plate number information is manually entered by the staff at the centre by referring the captured pictures. A notification of the fine is sent to the owner of the vehicle later. The vehicle registration and issuance of driver's licence are under the jurisdiction of the Road Transport Authority (RTA). The vehicle registration database which links the information of the vehicle owners and vehicle numbers was prepared. However, it is facing the following issues;

- The owners of the vehicles registered in other states can not be traced because the database is independently prepared by state.
- A residence registry such as available in Japan is not in place in India. The vehicle inspection system/scheme such as available in Japan does not exist in India. Therefore, the vehicle owners who changed their residence addresses and not reported to the RTA cannot be traced.

The integration of the vehicle registration database across all states and the introduction of a personal ID card are under consideration in India. The above issues would be eased if some combinations between the vehicle registration and personal ID card system are realised. However, it is not clear whether such consideration is being made by the concerned Indian authorities.

## **(10) Number Plate**

The specifications of number plates are not integrated. The number plates employ different plate materials, font sizes, setting positions, and languages across the regions. Thus, it is technically difficult to automatically detect and recognise them by sensors. The integration of vehicle plates is under consideration by the Indian government. The typical examples of the number plates are shown in the Figure below.



(Source: JICA Study Team, 2012)

**Figure 3-34 Examples of Vehicle Number Plates in India**

### **(11) Condition of Traffic Signal Facilities**

The number of traffic signals is seriously insufficient in the city. There are many cases that the traffic signals are not prepared in spite of the traffic volume, and not well maintained. Almost 70% of the traffic signals are not working in Ahmedabad. The electricity supply is not stable and thus the metropolitan cities in India face frequent blackouts. Accordingly, many of the traffic signals are equipped with the solar power panels and batteries. However large capacity of batteries and panels size shall be required in order to sufficiently guarantee functioning during the power failure and it is somehow doubtful whether such existing equipment is satisfactorily adequate. Thus, the improvement of electric infrastructure including power supply holds urgent necessity in the cities.

The type of traffic signals differs by city. For example, Split Cycle Offset Optimisation Technique (SCOOT) traffic signals are installed in Delhi, whilst Sydney Coordinated Adaptive Traffic System (SCATS) signals are available in Mumbai. However, such signals were installed at limited sections in the city. The signals installed in Indore, Mysore and Hyderabad are stand-alone types.



(Source: JICA Study Team, 2012)

**Figure 3-35 Battery Control Panel and Signals Equipped with Solar Panel**



**Figure 3-36 Traffic Signals (Pune)**

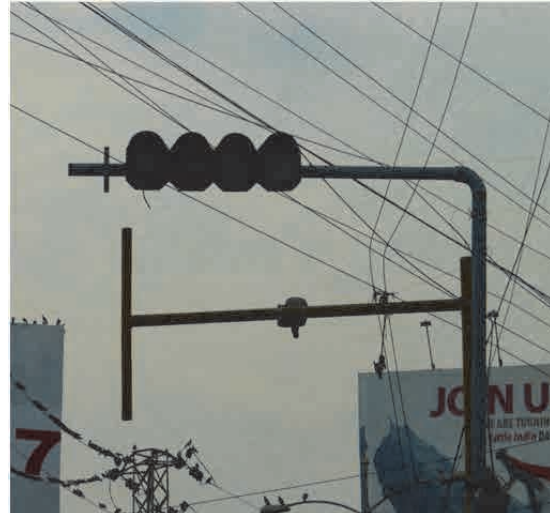


(Source: JICA Study Team, 2012)

**Figure 3-37 Traffic Signal (Delhi)**



**Figure 3-38 Traffic Signal (Mumbai)**



**Figure 3-39 Traffic Signal (Hyderabad)**

(Source: JICA Study Team, 2012)

## (12) Smart Card Availability

The mayfair based smart cards and electronic payment systems are available in the urban mass transport such as the Delhi metro, Bangalore metro, and Ahmedabad BRT. The smart cards that can be commonly used amongst different modes of transport are not yet in place in India. The importance of such system is increasingly recognised in the cities.

Under such situation, a pilot project for introduction of the common smart card was recently initiated in Delhi. The introduction of such common card is also under consideration in many other cities.

The introduction of the smart card which can be used across all cities in India, called “More Card”, was recently initiated by the Ministry of Urban Transport. However, majority of city level administrators share the opinion that the smart cards and payment systems which can be used within their cities or states would be enough and such card which can be used nation wide would not be necessarily required because many of the cities already prepared their own payment systems. Therefore it is not clear whether the “More Card” will penetrate throughout India.

The condition of the smart card introduction in the cities are summarised in the following table.

**Table 3-2 Condition of Smart Card Introduction**

City	Public Bus	BRTS	Metro	Monorail	Common Card
Delhi	Available	Available	Available	—	Under Pilot for Bus-BRTS-Metro
Ahmedabad	—	Available	—	—	—
Hyderabad	—	—	—	—	—
Bangalore	Available	—	Available	—	Under Consideration: Bus-Monorail
Chennai	Planned	—	Planned	Planned	Under Consideration: Bus-Metro-Monorail
Mysore	—	—	—	—	—
Indore	—	—	—	—	—
Mumbai	Available	—	Planned	Planned	Under Consideration: Bus-Metro-Monorail
Pune	—	—	—	—	—

(Source: Prepared by JICA Study Team based on Interview and Materials)



**Figure 3-40 Smart Card (Mumbai)**



**Figure 3-41 Smart Card Sales Point (Mumbai)**



(Source: JICA Study Team, 2012)

**Figure 3-42 Ticketing Gate of Metro (Delhi)**

### (13) Electronic Toll Collection (ETC) Standard

The ministerial order of the ETC standard on the national highway was issued by MoRTH in June 2010. The order stipulates the standard of RFID tag passive method, EPC Gen2 ISO 18000-6C, to be applied on the national highways in India.

The different types of ETC had been deployed in some locations before the order was issued. The examples include;

- Passive DSRC on the Delhi-Gurgaon section of National Road 8,
- Infrared on the Delhi-Noida Bridge,
- RFID tag on the bypass of Ahmedabad-Vadodara of National Road 8 (planned) and the Sea Link Road in Mumbai,
- Active DSRC on the outer ring road in Hyderabad (planned).

The On-Board Units (OBU) or tags have not sufficiently penetrated amongst users yet. In particular, the toll gates on Delhi-Gurgaon face serious chronic congestions due to the inflow of vehicles which are not equipped with the tags into the ETC exclusive lanes. The nonstop vehicles equipped with the tag are even rare.

The above said ministerial order of the ETC standard does not hold legal obligation and it targets on the national highways.



**Figure 3-43 Congestion at Toll Gate (Gurgaon)**



**Figure 3-44 ETC Gate (Gurgaon)**



**Figure 3-45 ETC Gate (Noida)**

(Source: JICA Study Team, 2012)



### **3-3-6 Communications Network**

The overall conditions of the communications network, including fibre optic network and mobile network, in India are described below.

#### **(1) Responsible Agencies**

The governing body in managing information and communications in India is the Ministry of Communications and Information Technology. The following departments under the said ministry exist and govern the telecommunications industry in India:

##### **1) Department of Electronics and Information Technology (DeitY)**

- Policy and promotion of IT, electronics, and the internet
- Promotion of hardware/software industry, IT export, and competitiveness
- Promotion of e-government, electronic medical care, and electronic commerce
- Promotion of IT education
- Standardisation in the field of IT and quality assurance
- Measurement of digital divide
- Collaboration with international institutions

##### **2) Department of Telecommunications (DoT)**

- Planning, development, improvement, operations, and maintenance of telecommunications
- Licensing
- International coordination
- Standardisation, research, and development of telecommunication
- Attracting foreign investments

##### **3) Telecom Commission**

- Policy making on telecommunications
- Licensing
- Frequency management
- Monitoring of government enterprises
- Research and development and standardisation of products

#### **4) Telecom Regulatory Authority of India (TRAI)**

- Introduction and promotion of new technology
- Assurance of interoperability and interconnectivity among technologies
- Setting of interconnection fees
- Recommendation of licence condition and assurance of adherence of licence conditions
- Promotion and assurance of competitiveness, efficiency, and growth
- Monitoring of consumer protection and service quality

#### **(2) Major Policies in the Telecommunications Sector in India**

The telecom industry in India was liberated and opened to the public in 1992. The National Telecom Policy was formulated to promote competitiveness and export in the international market in 1994. India experienced a series of significant reforms in the telecom industry since then. The recent major policies related to the broadband are as follows:

##### **1) Broadband Policy in 2004**

The Broadband Policy 2004 was published by DoT in October 2004. It aims to improve the quality of life and employment by promoting e-government, e-medical care, and remote education by deploying the broadband services. It stipulates that the downlink bandwidth shall be secured at least 256 kbps.

##### **2) National Fibre Optic Network Plan**

The National Fibre Optic Network Plan was approved by the Government of India in November 2011. It plans to deploy 2 Mbps of fibre optic cable network with a total length of 1.1 million km and connect all villages in India. The total budget for phase 1 was estimated at INR 200 billion. The fund is provided through the Universal Service Fund, which is intended for rural development, with the private sector leading the investment. The project is being carried out by SPV, which is composed of central public sector units, participated by Bharat Sanchar Nigam Limited (BSNL) and the central government. The promotion of employment and services in the area of e-government, remote medical care/education, and e-banking are expected.

#### **(3) Fibre Optic Network in India**

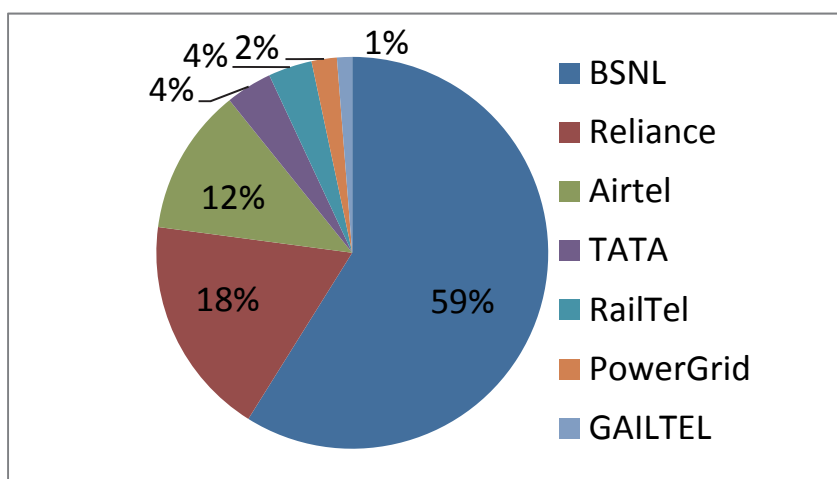
The total length of fibre optic network installed in India is at 1,043,684 km. The trunk lines cover almost all major cities. Some medium-sized cities and nearly all small villages still remain unconnected. The fibre optic cables are individually laid by government and private communications agencies. BSNL, a government enterprise, has the largest share of fibre optic network followed by Reliance which is a private company. The National Fibre Optic Network Plan aims to extend to these unconnected areas.

**Table 3-3 Fibre Optic Network Conditions**

Enterprise	Length (km)	Coverage		
		Major Cities	Medium-Sized Cities	Villages
BSNL	614,755	Very High	Very High	No
Reliance	190,000	Very High	Low	No
Airtel	126,357	Very High	Low	No
TATA	40,000	Very High	Low	No
RailTel	37,720	Very High	Medium	No
PowerGrid	21,852	Very High	Low	No
GailTel	13,000	Very High	Low	No
Total	1,043,684			

Shaded Agency: Public Companies

(Source: Prepared by JICA Study Team based on Telecom Reports)



**Figure 3-46 Share of Network Length by Provider**

#### (4) Mobile Communications Network

##### 1) Licensing Scheme and Service Areas

DoT and TRAI are the agencies in charge of licensing in the field of mobile communications. DoT formulates the licensing policies, and assesses or approves the licence. TRAI supervises the adherence of the stipulated conditions of the licence, and prepares the regulations on the fees, interconnectivities amongst the service providers, etc.

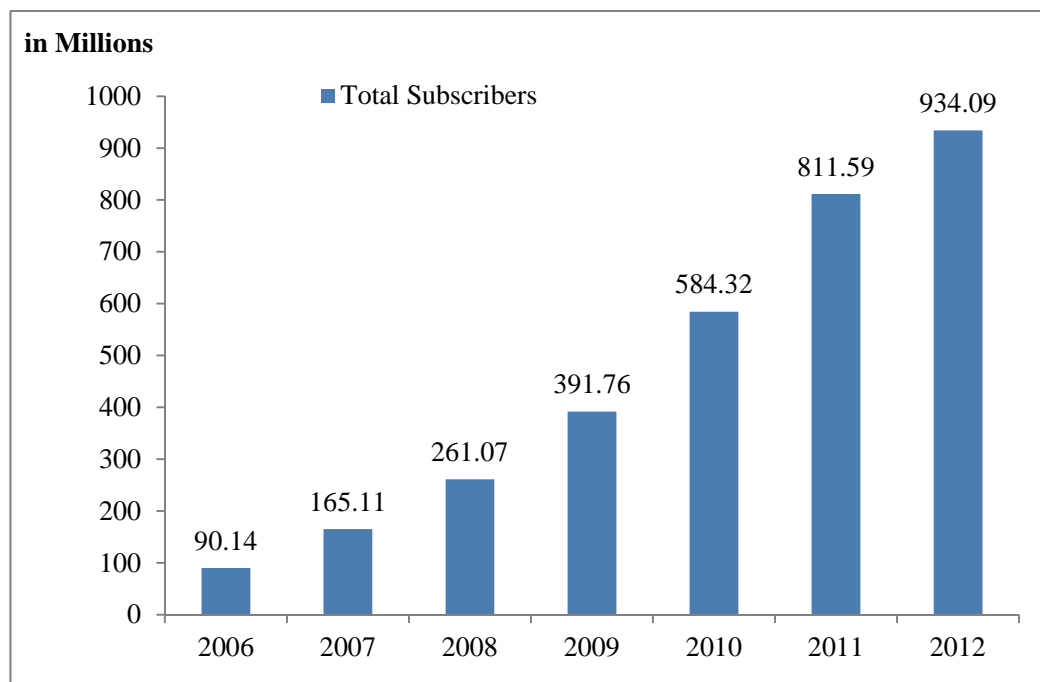
The service areas are divided into 23 circles, which consist of four metropolitan circles including Delhi, Mumbai, Kolkata, and Chennai, as well as 19 other circles in accordance with the state divisions. They are categorised into A, B, and C together with licensing fees according to the profitability ratio.

## 2) Number of Mobile Subscribers and Service Providers

India is the second largest market of mobile phones in the world, next to China. The total number of mobile subscribers is at 934 million and maintains a high growth ratio. Of all mobile users, 95% of them are subscribed to prepaid service.

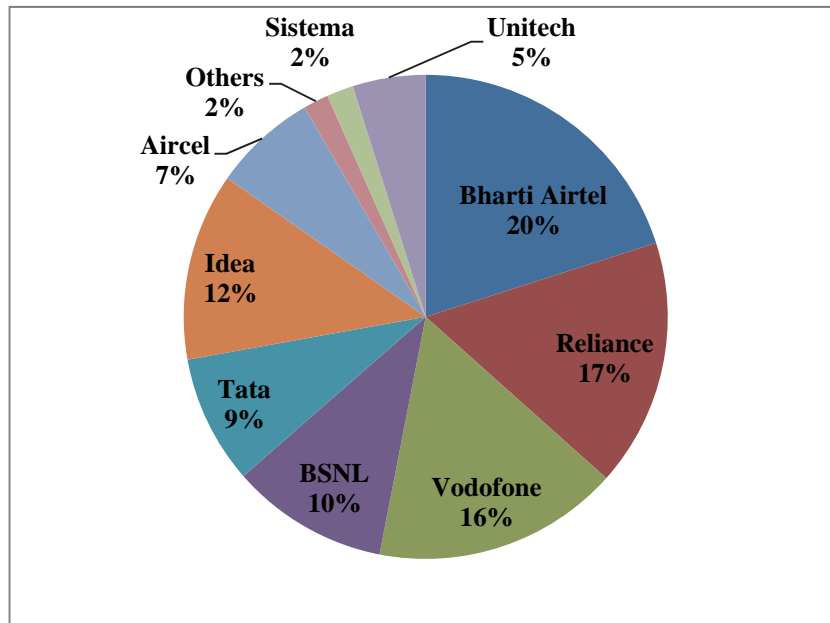
There are 15 private service providers and two governmental service providers, BSNL and MTNL. The largest service provider is Bharti Airtel, followed by Reliance, Vodafone, BSNL, and Tata Docomo. NTT Docomo has a 26% stake in Tata Docomo. GSM and CDMA services are available in India.

The following Figures show the growth rate of subscribers and market share amongst service providers, respectively.



(Source: Prepared by JICA Study Team based on Telecom Reports, 2012)

**Figure 3-47 Growth of Mobile Phone Subscribers**



(Source: Prepared by JICA Study Team based on Telecom Reports, 2012)

**Figure 3-48 Market Share of Mobile Phones**

### **(5) 3G and 4G Networks**

BSNL/MTNL started providing 3rd Generation (3G) services in December 2008. In November 2010, Tata was the first private enterprise to provide 3G services. Other providers followed later on, and 3G services spread all over India.

The Government of India called for bids for the frequency of 3G network in the 22 circles in June 2010. The government approved the licences for the wireless stations to the successful bidders. The total amount of bids reached JPY 927.6 billion.

The Government of India also called for bids for the frequency of broadband wireless access at 2.3GHz in 2010, as 4G network. The successful bidders include Airtel, Infotel and etc. The 4G services are gradually started since then.

It can be expected that such services may positively affect the field of ITS in India if they become fully available and the quality of services is assured.