REPUBLIC OF INDIA HYDERABAD METROPOLITAN DEVELOPMENT AUTHORITY/ HYDERABAD GROWTH CORRIDOR LIMITED

# JICA SPECIAL ASSISTANCE FOR PROJECT IMPLEMENTATION (SAPI) FOR THE ASSISTANCE FOR THE INTRODUCTION OF ITS ON ROAD NETWORK IN HYDERABAD METROPOLITAN AREA IN INDIA

# **SUMMARY OF FINAL REPORT**

**March 2014** 

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) JICA STUDY TEAM Consisted by

> N I P P O N K O E I C O . , L T D . EAST NIPPON EXPRESSWAY CO., LTD. METROPOLITAN EXPRESSWAY CO., LTD.



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# LOCATION MAP



# 1 Introduction

# 1-1 Study Background

Hyderabad is one of six (6) major metropolises in India. It is the capital city of Andhra Pradesh state in South India and located almost in the middle of the country surrounded by Mumbai in west, Bangalore in south and Chennai in southeast.

Hyderabad has been developing as a growth base of international business, represented by the industries of information technology and pharmacy. Traffic has been significantly increasing with rapid urbanisation in recent years. As a result, severe traffic congestion is becoming a social problem, hindering smooth business activities. Thus, there is an urgent need to alleviate traffic congestion.

Under this situation, construction of Outer Ring Road (ORR) is underway to ease congestion by reducing the number of vehicle passing through the city, thereby contributing to regional economic development in suburban area and improvement of the urban environment. Intelligent Transport Systems (ITS) will be developed on ORR by Japanese yen loan project for efficient management of highway and toll collection

In the city of Hyderabad, some governmental bodies and private enterprises recently began developing ITS. However the status of ITS in the city remains in a piecemeal manner, and the systems are planned by individual bodies in an uncoordinated way.

In this background, the state government of Andhra Pradesh requested the government of Japan to carry out a study to prepare a comprehensive ITS Master Plan for Hyderabad Metropolitan Area (HMA).

As a result, Hyderabad Growth Corridor Limited (HGCL) under Hyderabad Metropolitan Development Authority (HMDA) and Japan International Cooperation Agency (JICA) agreed that both parties would sincerely cooperate with each other with a view to contributing towards the smooth introduction of ITS in Hyderabad Metropolitan Area by formulating ITS Master Plan and preparing design of pilot prject for the prioritised ITS services.

# 1-2 Study Objectives

The objectives of the study is to assist Andhra Pradesh State Government and Hyderabad city authority to improve and modernise the traffic and transporation system in Hyderabad through formulating ITS Master Plan and prioritising ITS projects in Hyderabad Metropolitan Area which can be implemented in a phase manner. The study also aims to assist HMDA/HGCL by preparing tender document for the prioritised ITS as a pilot project in Phase-1 of the Master Plan, which will be funded through current JICA loan for Hyderabad Outer Ring Road Phase2.

# 1-3 Study Area

The study area shown in Figure 1 covers inside ORR with the prime focus on the core area of the city where the traffic congestion has been significantly serious in recent years.



Figure 1 Location Map of the Study

# **1-4** Scope of Works

1

The scope of works includes (i) formulation of ITS Master Plan for Hyderabad Metropolitan Area, (ii) selection of pilot project(s) for prioritised ITS services, (iii) design of pilot project(s), (iv) preparation of draft tender documents, (v) preparation of operation & maintenance manual, and (vi) preparation of road inventory. The table below lists the scope of works in accordance with terms of reference of JICA.

#### Table 1Scope of Works

Preparation of ITS Master Plan for Hyderabad Metropolitan Area

- 1-1 Review of Current Condition in Hyderabad Metropolitan Area, including: Current Traffic Volume and Traffic Condition Road Network and Congestion Situation Traffic Demand and Traffic Assignment **Existing Facilities for Traffic Control Existing Facilities for Information Provision** Traffic Accident **Public Transport** Existing Related Plans, including Comprehensive Transportation Plan 1-2 Formulation of Policy for ITS Introduction, including: Clarification of Demarcation between Public and Private Sectors for ITS Introduction and **Operation/Maintenance** Evaluation of Needs of ITS and Effect of ITS Introduction 1-3 Conceptual Design of ITS Projects, including: Outline of System **Rough Cost Estimate** Expected Effect and Conditions for Introduction Systems to be Considered Traffic Control and Monitoring System utilising CCTV Camera, Traffic Counter and Probe Car System Traffic Information Provision System utilising Media such as VMS Information Exchange Signal System Traffic Demand Control Bus Location System and IC Card
- 1-4 Assistance for Organisation Setup for ITS, including:
  - Review of Roles and Responsibilities of Existing Organizations
  - Proposal of Roles and Responsibilities of New Organisation
  - Related Existing and Required Laws and Regulations
- 1-5 Proposal of Funding Scheme and Economic/Financial Evaluation, including:
  - Cost Estimate for ITS Introduction and Operation
  - Funding Scheme in Other Countries
  - Proposal of Funding Scheme including Possibility of Private Sector Involvement
  - -Economic and Financial Analysis Considering Benefit and Income
- 1-6 ITS Master Plan Formulation, including:
  - Preparation of Road Map
  - Consideration of Latest Technology and Related Laws and Regulations

- Lists of Project and Implementation Schedule in Phases and Category
- 1-7 Assistance for Capacity Building for ITS
  - Workshops
  - Participation in ITS World Congress
- 2 Assistance for Pilot Project
- 2-1 Selection of Pilot Project for Prioritised ITS Services as follows:
  - ITS Control Centre and Equipment
  - Data Collection System by Bus Probe System and Traffic Counter
  - Information Provision System by VMS, Internet and SMS
  - Flood Monitoring System and Meteorological Monitoring System
  - Data Analysis
  - Road Inventory
- 2-2 Preparation of Basic Design of Pilot Project, including:
  - · Covered Area
  - Component and Specification of Equipment
  - Specification of Operation and Maintenance
- 2-3 Preparation of Draft Tender Document, including:
  - Procurement of Equipment
  - Procurement of Operator
- 2-4 Preparation of Operation and Maintenance Manual
- 3 Others
- 3-1 Supplement Traffic Survey

# **1-5** Study Schedule

The entire work period of the study is approximately 31 months, beginning with the preparatory work in August 2011 and submission of the final report in February 2014. The study is divided into two stages with the following objectives:

- Phase-1: Formulation of ITS Master Plan
  - Phase-2: Basic Design and Preparation of Tender Documents for Pilot Project



Source: JICA Study Team

Figure 2 Study Schedule

# **1-6** Study Outputs

The following outputs were prepared by this study:

- Final Report (English, including ITS Master Plan for Hyderabad Metropolitan Area, Tender Documents and Road Inventory)
- Summary of Final Report (English and Japanese)

# 2 Current Condition and Required Measures by ITS in Hyderabad

# 2-1 Current Condition

### 2-1-1 Outline of Hyderabad Metropolitan Area

Hyderabad is a capital city of Andhra Pradesh state. Hyderabad Metropolitan Area (HMA) is one of six (6) major metropolises in India and located almost in the middle of Mumbai, Bangalore and Chennai. The total area of HMA is nearly 7,200 sq. km.

It has been a growth base for international business such as information technology, pharmacy, etc. in recent years. The population and number of vehicles have been rapidly growing in the HMA.

The highways connecting to other cities cross in radial pattern in the centre of the city. Severe traffic congestion is commonly seen due to increasing in number of automobiles that pass through the city and run within the city.

#### 2-1-2 Administration in Hyderabad

Hyderabad Metropolitan Development Authority (HMDA) is a responsible body for planning, co-ordination, supervision and promotion of development in HMA. It coordinates the development activities of related bodies such as municipal corporations, municipalities and other authorities. Figure 3 shows entire Hyderabad Metropolitan area.





Figure 3 Hyderabad Metropolitan Area

HMDA was constituted by the Andhra Pradesh government order in 2008. HMDA was formed by combining the entire suburbs of Greater Hyderabad Metropolitan Corporation (GHMC). The

jurisdiction of HMDA consists of 55 mandals, which is lower local bodies in district, in five districts. The five districts are: i) Hyderabad (all 16 mandals), ii) Medak (10 mandals), iii) Rangareddy (22 mandals), iv) Mahaboobnagar (2 mandals) and v) Nalgonda (5 mandals). The jurisdiction area of HMDA is approximately 7,200 sq. km.

Unified Metropolitan Transport Authority (UMTA) is a high level coordinating and decision-making body for urban transport in Andhra Pradesh state. National Urban Transport Policy (NUTP) encourages setting up UMTA in the cities of million-plus population in India. It was established in Hyderabad in 2008. The metropolitan commissioner of HMDA is a member convenor of UMTA.

## 2-1-3 Population

The population in HMA is rapidly growing. The core area and Ragareddy district area are mostly populated. According to the population census of Directorate of Census Operations, the population in HMA increased from 5.78 million in 1991 to 7.6 million in 2001, 32% increase, and to approximately 9.4 million in 2011, 23% increase.

## 2-1-4 Environmental Condition

Air quality in HMA has been seriously deteriorated. Andhra Pradesh Pollution Control Board (APPCB) publishes the annual report on air quality and noise level in HMA and entire Andhra Pradesh. According to the report in 2012, the respirable suspended particulate matter (RSPM) and total suspended particulate matter (TSPM) were exceeding their upper limit whilst sulphur dioxide (SO<sub>x</sub>) and nitrogen dioxide (NOx) stay within the limits.

The annual report on the noise in 2012 shows that the noise level in HMA exceeds the upper limit, as summarised below:

- The noise level was measured at approximately 73 dB in commercial areas.
- Higher noise levels of 52 and 54 dB were measured in noise-sensitive locations, which are Zoo Park and Kasu Brahmananda Reddy National Park (KBRN).

# 2-1-5 Tourism

Tourism is an important industry for Indian economy. The number of foreign tourists, called Foreign Touris Arrivals (FTA), has been rapidly growing and it has doubled during the last decade. In 2012, FTA in India was 6.64 million with a growth rate of 5.4% from 2011. Andhra Pradesh state is ranked at the 12th for FTA with 0.292 million visitors in 2012, which is 4.4% of total FTA in India. The number of tourists in Andhra Pradesh state increased in 2012 from 0.268 million in 2011. However it recently decreased in Hyderabad.

There are attractive tourist spots and historical places such as Golkonda Fort, Charminar, etc., in HMA. However essential information such as explanation of historical exhibit, guidance for tourists indicating the location of nearest parking, etc. is not sufficiently provided in these places. There is a potential for attracting more tourists if more appropriate information on tourism is provided to visitors.

# 2-1-6 Road Networks

Major national highways (NH) and state highways (SH) pass through Hyderabad. The national highways include NH-44 (old NH-7), NH-65 (old NH-9) and NH-163 (old NH-202), and the state highways include SH-1 (to Karimnagar), SH-2 (to Nagarjunasagar), SH-4 (to Vikarabad), SH-5 (to Srisailam) and SH-6 (to Medak). These highways are 4 or 6 lanes and other roads are basically double-lane.

Inner Ring Road (IRR) passes around the centre of the city and connects with major surrounding areas. Outer Ring Road (ORR) is currently under construction and will pass through the suburban area in HMA.

The state road network is developed to link the national highways and major road network of the city. IRR connects with major junctions in the city and accommodates the inner city traffic. ORR is constructed to divert the traffic in the central areas of the city, thereby enhancing economic development in surrounding region.

HMA road network consists of 5,443 km roads including NHs, SHs, HMDA roads, IRR (50 km), and ORR (158 km).







#### 2-1-7 Current Traffic Volume and Condition

The most noticeable feature of traffic in Hyderabad is 'heterogeneous traffic' and the dominant mode is 2-wheeler comprising 57% in 2012.

The composition of the traffic is shown in Figure 5. They are;

- 2-wheelers (motorcycle),
- 3-wheelers (auto-rickshaws),
- Buses (APSRTC and private bus),
- Private cars,
- Taxi and cabs, and
- Commercial vehicles.

The public transport in the city is heavily dependent on road-based modes such as buses,

auto-rickshaws (3-wheelers) and taxies. The rail-based mode is not a major public transport in Hyderabad city yet.



Source: CTS Report, 2011

Figure 5 Comparison of Vehicular Composition

## 2-1-8 Public Transportation

#### (1) City Buses

Andhra Pradesh State Road Transport Corporation (APSRTC) is a state bus service operator. They mainly provide inter-city and inter-state bus services in the state. They also offer the city bus services in Hyderabad city. They operate approximately 3,800 buses for 865 routes as city-bus services in Hyderabad city.

#### (2) Local Trains (MMTS)

The Multi-Modal Transport System (MMTS) is a suburban railway in Hyderabad. It is operated by a joint partnership of state government of Andhra Pradesh and South Central Railway (SCR). The operation in the first phase started in August in 2003. It covers 27 stations and carries approximately 1,500,000 passengers per day. There are first class, general class and special ladies compartment.

#### 2-1-9 Existing Regional Development Plans and Related Studies in Hyderabad

Based on the current review, the existing regional development plans in Hyderabad which shall be taken into account are summarised below:

1.	Urban Development Plans
(1)	Revised Master Plan for Core Area
(2)	Master Plan for Extension Area of Hyderabad
(3)	City Development Plan
2.	Road Transportation Plans
(1)	Comprehensive Transportation Action Plan for Hyderabad
(2)	Development of Hyderabad Multi Modal Suburban Commuter Transportation System (Phase II)
(3)	Hyderabad Metro Development Plan
(4)	Outer Ring Road

 Table 2
 Existing Regional Development Plans and Related Studies

3.	ITS Related Plans
(1)	Outer Ring Road (ITS Components)
(2)	Integrated Traffic Signal System in Hyderabad
4.	Related Major Studies
(1)	Comprehensive Transport Study
(2)	Hyderabad Area Transportation Study – HATS (1986)
(3)	Data Base of Hyderabad Area Transportation Study – HATS II (1986)

# 2-1-10 ITS Related Plans

# (1) ITS on Outer Ring Road (ORR)

ITS facilities are planned to develop on ORR by JICA loan. It includes Toll Management System (TMS) for automatic toll collection and Highway Traffic Management System (HTMS) for traffic management.

# (a) Highway Traffic Management System (HTMS)

The components of HTMS include 1) Traffic Control Centre, 2) Automatic Traffic Counting and Classification, 3) Closed Circuit Television, 4) Emergency Call Box, 5) Meteorological Stations, and 6) Variable Message Signboards.

## (b) Toll Management System (TMS)

A total of 157 manual and touch & go lanes and 23 non-stop ETC lanes are planned at 19 interchanges on ORR. The main traffic control centre will be constructed at Nanakramguda interchange and sub-traffic control centre as data backup centre at Ghatkesar interchange. Active DSRC is planned for the non-stop ETC.

# (2) Integrated Traffic Signal System in Hyderabad

Replacement of existing signals and installation of new signals are underway by Hyderabad Traffic Police and Greater Hyderabad Municipal Corporation. It is called Hyderabad Traffic Integrated and Management System (HTRIMS). The project is carried out by Build-Operater-Transfer, BOT, scheme for a period of five (5) years of operation. It includes the following component:

- To develop Traffic Command Centre (TCC) in the existing headquarters of Hyderabad Traffic Police, and back-up centre in Cyberabad Traffic Police,
- To installe the signals at 221 junctions, including 180 existing signals and 41 new signals,
- To adopt automatic signal phase adjustment according to traffic volume at junction, which is called virtual loop, at some junctions,
- To remotely operate the signalling parameters from the TCC or at site,
- To monitor the health of the signal facilities from the TCC.

# (3) Bus Information System by APSRTC

A project to develop bus location system, which is called Vehicle Tracking and Passenger Information System, is underway by APSRTC. The system monitors the locations of buses from control room and provides the information of bus schedule and expected bus arrival time to the passengers at bus stop. The contractor of the project was awarded to M/S CMC Ltd. GPS units will be installed on approximately 1,350 city buses.

## 2-1-11 Existing ITS in Hyderabad

### (1) Traffic Control Centre (TCC) of Traffic Police

The traffic control centre (TCC) of traffic police is in operation in Hyderabad. It is located at the headquarters of the traffic police. 420 CCTV are installed at junctions in the city and the condition at site is monitored at TCC. The personnel of traffic police are deployed in various locations in the city, mainly at junctions to handle the traffic. They communicate with the operators at TCC through mobile wirelss handset. The traffic signals which will be installed by HTRIMS project will be connected to the TCC.

#### (2) Signal Violation Enforcement System

The signal violation enforcement system is operated by traffic police. If the vehicle ignores the traffic signal at junction, CCTV installed at the junction captures the static image of the number plate of the vehicle. The image is shown in the traffic control centre (TCC). The operator at TCC inputs the captured number plate into the database and the vehicle owners are identified. A violation penalty notice is issued to the owner of the vehicle. The system is called 'e-challan'.

#### (3) Taxi Dispatching System

The taxi services in Hyderabad are offered by private taxi companies such as Meru Cabs, Cell Cabs, etc. There is a call centre where the customers call up and book the taxi. The call centre monitors the locations of available taxies from the nearest place of the customer. The taxies are equipped with GPS and their locations together with the status of vacancy of customer are indicated on the map in the call centre. The taxies are dispatched upon confirmation of availability. The name and mobile number of the taxi driver and confirmation number are sent to the customer by SMS.

# **2-2** Identified Issues

### 2-2-1 Summary of the Identified Issues

Based on the review of the current conditions and existing plans, the major issues in the Hyderabad city are identified as summarised below;

Category	Identified Issues		
Regional	Rapid growth of population (up to 2.5 times from 1991) due to continuous		
Socio-Economic	migration into the city of Hyderabad.		
Characteristics	Sprawl growth of urban area.		
Regional Traffic	Rapid growth of vehicles, high proportion of motorcycle and auto rickshaw,		
Characteristics	heterogeneous traffic composition, heavy traffic volume inside IRR,		
	chronic traffic congestion inside IRR and major roads.		
	Low average travel speed, traffic mixed with low speed vehicles e.g. auto		
	rickshaw.		
Regional Transportation	Insufficient connectivity between different transport mode, limited number		
Characteristics	of railway crossing, insufficient information of the public transport,		
	improper location of bus stops, insufficient maintenance of the public		
	transport, large proportion of road transport mode usage, insufficient		
	ticketing system, declining quality of bus services, increasing number of		
	road traffic fatal accidents.		
Road Infrastructure	Insufficient road infrastructure to accommodate the traffic demand in the		
	city, absence of hierarchical road classification, insufficient facilities		
	including sidewalks encroachment, inadequate parking spaces, improperly		
	designed junctions/intersections, not properly working signals etc.		
Traffic Manner	Lack of traffic discipline including lane hogging, no helmet, signal		
	jumping, railway crossing pedestrians, wrong way driving, frequent phone		
	usage, excessive number of people on vehicles/motorcycles, forcible		
	overtaking.		
	Insufficient awareness of importance of traffic discipline.		
Existing Facilities	Not sufficient maintenance, absence of systems which support for		
8	planning/traffic and road management, absence of data base such as traffic		
	data, road inventory, absence of cash less system, absence of travel		
	information/traffic information, signals installed on the intersections which		
	are not properly designed, insufficient facility for public transportation		
	information provision.		
Facility Management	Complex structure of facility management through procurement.		
	installation, operation and management. (e.g. traffic signal procured,		
	installed and maintained by GHMC, managed by Traffic Police and		
	out-sourced to the private company for operation by BOT)		
	The responsibility becomes unclear and results in lack of consistency for		
	proper operation and management.		
Administrative	Insufficient coordination for infrastructure planning, traffic management.		
Structure	road management.		
	Different agencies involvement for road and facility management including		

 Table 3
 Summary of Identified Issues

Category	Identified Issues
	procurement, construction/implementation, operation and maintenance,
	complicated jurisdiction demarcation of road network, lack of human
	resources, lack of finance, lack of engineering experience/knowledge.

# 2-2-2 Most Critical Issues from a View Point of ITS

In addition to the above, the most critical issues in Hyderabad from a viewpoint of ITS are as follows:

#### Table 4Most Critical Issues in Hyderabad

# Most Critical Issues in Hyderabad

- (a) Absence of Quantitative Traffic Data
- (b) Absence of Centrally Coordinated Administrative Structure
- (c) Lack of Basic Infrastructure
- (d) Insufficient Proper Facility Maintenance
- (e) Absence of National Framework

The details are explained below.

## (1) Absence of Quantitative Traffic Data

The road infrastructure and traffic management need to be properly planned, implemented and improved for greater positive effects. This can be realised by utilizing the accumulated quantitative traffic data. However there are no basic facilities which can collect, cumulate and evaluate the measures taken. In addition, no major initiatives have been taken for this matter by the implementing and planning agencies either.

#### (2) Absence of Centrally Coordinated Administrative Structure

Different agencies are planning ITS related facilities in Hyderabad. However these plans are not sufficiently coordinated among the involved agencies and this results in lack of integration and proper maintenance. The planning, implementation and evaluation of traffic management, road/transport infrastructure and urban development need to be carried out in well-coordinated manner among the related agencies. It is assumed that the absence of such coordination is one of the prime causes of many issues in Hyderabad.

#### (3) Lack of Basic Infrastructure

ITS is one of soft measures. Road infrastructure needs to be properly developed to bring out effect of ITS. For example, properly designed junctions/intersections, strait-structured road, footpath appropriately developed for pedestrians, etc. are basic conditions. However such road infrastructure is not sufficiently developed in Hyderabad. In addition, lack of driving manners is also challenging issue although it is not infrastructure in Hyderabad. For example, keeping lane is important factor to measure traffic by ITS.

#### (4) Insufficient Proper Facility Maintenance

Some preliminary facilities are in place in Hyderabad. They include CCTV at junctions, traffic signals, signal jumping violation equipment, etc. However many of them are not properly working due to insufficient proper maintenance. The reasons for this derive from the related issues including lack of human resources, finances, infrastructure, know-how, coordination among the agencies, etc. Assurance

of the proper maintenance needs to be addressed for sustainable ITS operation.

#### (5) Absence of National Framework

ITS is a broad concept, which is not limited to particular facilities such as traffic signals. It involves a wide range of different subsystems and needs to be properly integrated / harmonized to function as a whole. It would be ideal to prepare the ITS under the framework of the National Policies. However the introduction of ITS has just started in recent years in India, and thus National policies have yet been established.

# 2-3 Required Measures by ITS for Hyderabad

Under the above conditions, the required measures which shall be realised by the ITS in Hyderabad are:

	<b>Required Measures by ITS for Hyderabad</b>
1.	Basic Data Collection and Proper Monitoring
2.	Proper Road and Traffic Strategy
3.	Proper Road Management
4.	Proper Traffic Control
5.	Proper Decision Making
6.	ITS Promotion on Commercial Base
7.	Coordination with Central Government for National Level ITS Policy
8.	Establishment of Central Organisation

 Table 5
 Required Measures by ITS for Hyderabad

The issues addressed by the above measures are interrelated in the Figure below.



Figure 6 Target Items and Required Measures by ITS for Hyderabad

It should be stressed that it is important to start taking steps toward preparation and development of ITS in Hyderabad, as a soft measure for proper road and traffic management.

# **3 Procedure for Formulation of ITS Master Plan for Hyderabad**

The basic policies are set out for introduction and implementation of ITS in the Hyderabad Metropolitan Area as follows.

# 3-1 Methodology for ITS Master Plan for Hyderabad

ITS is composed by a number of different subsystems including advanced ones that are implemented in various countries in the world. For applying ITS to Hyderabad Metropolitan Area, the particular local condition needs to be considered. However, there are many good examples from other countries which can be used as reference for consideration of ITS in Hyderabad. Thus, the following methodology, as shown in the figure below, is applied for preparation of ITS Master Plan to best suit Hyderabad Metropolitan Area.





# 3-2 Major Events Taken for Formulation of ITS Master Plan

ITS Master Plan in Hyderabad was formulated through the following major events.

Figure 8 C	Chronology	of Events	happened	during	Project	study	period
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Improtant Event	Contents
ITS Advisory Team Setup (September 2011)	<ul> <li>To exchange opinion and building consensus amongst the related stakeholders</li> <li>First meeting was held on 7<sup>th</sup> in September, 2011</li> <li>Second meeting was held on 15<sup>th</sup> in December, 2011</li> </ul>
Technical Advisory Committee (TAC) Setup (December 2012)	<ul> <li>To review, examine and advice HMDA/HGCL on HTMS, TMS of ORR and ITS Master Plan of Hyderabad City</li> <li>Formulated by new Commissioner, HDMA with technical experts of various ITS-related agencies in India</li> <li>First meeting was held on 1<sup>st</sup> in December, 2012</li> <li>Second meeting was held on 19<sup>th</sup> inJanuary, 2013</li> <li>Third meeting was held on 4<sup>th</sup> in May, 2013 for finalisation of proposed ITS user services</li> </ul>
Seminar on: Urban Transportation Planning	<ul> <li>One-day Seminar on Urban Transportation Planning, Problems and Prospects</li> <li>Seminar hosted by HMDA as part of Comprehensive</li> </ul>

(7 <sup>th</sup> June 2012)	Transportation Study (CTS)
(* * * * * * * * * * * * * * * * * * *	• Study on ITS Master Plan in Hyderabad was presented by JICA study team
	• One-day Workshop on ITS Master Plan for Hyderabad hoseted by HMDA on 14 <sup>th</sup> in September, 2012
ITS Workshop (14 <sup>th</sup> September 2012)	• To provide a platform to elicit stakeholders' views and suggest suitable measures to enhance ITS services for Hyderabad
	• Discussed Topics: ITS services to be delivered, proposed Ttechnologies, procurement methods, operation and maintenance, etc.
Various Meetings	Regular weekly/bi-weekly/monthly meetings with
Between HMDA and JICA	HMDA officials such as Chief Engineer, General
Study Team	Manager, etc and JICA study team
UMTA Meeting	• UMTA (Unified Metropolitan Transport Authority) meeting was held to discuss the proposed ITS Master Plan for Hyderabad.
(11th November 2013)	• The proposed ITS Master Plan for Hyderabad was approved by UMTA
HMDA Board Meeting (11th November 2013)	• HMDA Board meeting was chaired by Chief Minister of Andhra Pradesh State to discuss the proposed ITS Master Plan for Hyderabad.
	• ITS Master Plan was approved by HMDA board members
Public Opinion on ITS Master Plan (November 2013)	• ITS Master Plan for Hyderabad was published for public comment seeking objections and suggestion from general public and stakeholders on 27 <sup>th</sup> November, 2013 until 31 <sup>st</sup> January, 2014
ITS Master Plan Final Submission (February 2014)	• ITS Master Plan for Hyderabad was finalised, reflecting all above, and submitted by JICA study team to HMDA

# 4 ITS Master Plan for HMA

# 4-1 Goals and Objectives of ITS

The ultimate goals of ITS are set out as: 1) Safety, 2) Environmental / Energy, 3) Productivity, 4) Mobility, 5) Efficiency and 6) User Satisfaction. The objectives to be achieved by ITS in line with the goals are summarised as follows:

No.	Goal	Objectives	
1	Safety	• To reduce risk in transportation	
		• To reduce traffic accidents	
		To enhance communication and response in emergency	
		• To reduce damage in disaster	
2	Environment / Energy	• To reduce air pollution	
		• To reduce CO2 emissions	
		To reduce energy consumption	
3	Productivity	• To increase national or regional economic output through efficien utilisation of transport facilities	
4	Mobility	To increase efficiency in reaching destination	
		• To reduce travel time	
		• To reduce travel costs	
		• To give care to disabled people	
5	Efficiency	• To invest efficiently in traffic related infrastructure	
		To increase efficiency in road use	
		To reduce cost of road management	
		To enhance appropriate management of ITS data	
6	User Satisfaction	• To increase satisfaction with safety, environment and mobility	
		To increase satisfaction with convenient life	

Table 6Goals and Objectives of ITS

# 4-2 Proposed ITS Services for Hyderabad

# 4-2-1 ITS Services to be Introduced in Hyderabad

The ITS services which need to be introduced in Hyderabad are identified as shown in the Table below. They were selected by referring to the practices included in the user services in ITS Architecture in the world.

No.	User Service Bundle of World ITS	ITS Services for Hyderabad		
1.00	Architecture			
1	Traffic Management and Operations <sup>(150)</sup>	Data Collection		
		Information Provision		
		Traffic Control		
		Optimum Route Guidance		
		Parking Management		
2	Public Transport <sup>(ISO)</sup>	Bus Operation		
		Rail Transportation		
		Taxi / Auto Rickshaw Operation		
3	Emergency (ISO)	Emergency Alert and Response		
		Emergency Optimum Route Guidance		
		Emergency Signal Control		
4	Transport-Related Electronic Payment	Transport-Related Electronic Financial Transactions		
		Integration of Transport-Related Electronic Payment		
		Services		
5	Road Transport-Related Personal Safety	Driving Support		
	(ISO)	Signal Dedicated for Pedestrian		
6	Weather and Environmental Conditions	Collection of Weather Information		
	Monitoring <sup>(ISO)</sup>	Collection of Air Pollution Information		
7	Disaster Response Management and	Disaster Alert and Response		
	Coordination (ISO)	Disaster Operation Assistance		
8	ITS Data Management	Collection, Store and Aggregation of Data		
		Traffic Data Analysis		
		Traffic Accident Analysis		
		Emergency and Disaster Information Analysis		
9	Maintenance and Construction	Road Management		
	Management			
10	Law Enforcement	Assistance of Police Activities		
		Automated Speed Enforcement		
		Automated Signal Jumping Enforcement		
		Automated Wrong way Driving Enforcement		
		Automated Illegal Parking Enforcement		
		Automated Overloaded Vehicle Enforcement		
		Automated Over-height Vehicle Enforcement		

Table 7ITS Services for Hyderabad

# 4-3 Road Map for ITS in Hyderabad

### 4-3-1 Phased Implementation Policy

In consideration of the current condition in Hyderabad and required measures, ITS shall be prepared in phased manner as shown in Table 8 and Figure 9. The first priority shall be preparation of the basis ITS component and more advanced services be gradually expanded. The road infrastructures need to be improved along with expansion of ITS. The advanced ITS components are gradually introduced in accordance with road infrastructure improvement and maturity of ITS industry.

Phases	Policy
Phase-1 (1-5 years)	Establishment of ITSC
	Preparation of Basic ITS Component
Phase-2 (6-10 years)	Expansion of Basic ITS Component
	Introduction of Advanced ITS Component
Phase-3 (After 10 years)	Expansion of More Advanced ITS Component

Table 8	Phased	Implementation	Policy
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Figure 9 Road Map for ITS in Hyderabad

## 4-3-2 Establishment of ITS Centre

It is strongly recommended to establish a single agency, temporarily called ITS Centre, which shall be responsible for planning, procuring, installing, operating and managing ITS.

It is also necessary for planning of ITS to have consistency with the national ITS framework in India and to coordinate with the central governments and regional public agencies in neighbouring regions. The traffic information generated by the ITS Centre shall be provided to the private sectors with/without charge.

The image of ITS Centre to be established is shown in the figure below.



Source: JICA Study Team

Figure 10 ITS Centre to be Established in Phase-1

# 4-3-3 ITS Equipment Installation Policy

The ITS equipment will be installed to cover major roads and important areas in city at first in Phase-1. The target areas include national roads, Inner Ring Roads and other critical locations including heavily congested sections in the centre of the city. The coverage areas will be gradually expanded in the following phases and ultimately covers the entire areas of Hyderabad in Phase-3.

## 4-3-4 Master Plan Implementation Schedule

The Master Plan of ITS for Hyderabad shall be implemented as shown in Table below.

Items	Phase-1	Phase-2	Phase-3
Installation	- Major road: NH-44 (old	- Distribute road: radial road	- Link road: the road linking
Priority	NH-7), NH-65 (old	- Link road: the road linking	between major junctions
	NH-9), NH-163 (old	between above roads	- Residential road
	NH202), IRR, SH	- Other important locations	- Important locations on
	- Other important		colony road
	locations in city		
	Installation shall be postpor	ned to avoid re-working on the sect	tions with planned civil
	construction/improvement	which includes e.g.:	
	• Widening/Extension	n on Radial Road	
	<ul> <li>Sections along Plan</li> </ul>	ned Metro Construction	
ITSC	- ITSC establishment	- Expansion of system in 2nd	- Expansion of system in
	- Organisation setup	phase.	3rd phase.
	- Preparation of 1st phase		
	systems		
	ITSC Roles:		
	<ul> <li>Traffic monitoring a</li> </ul>	and analysis, traffic information pro	ovision, traffic control
	• Planning, implement	ntation, evaluation of ITS	
	• System integration,	ITS development initiative	
Collection	CCTV, ATCC, Probes,	Expansion of those left	Expansion of those left
Method	personal information		and Human Probes
	from agencies and		
	citizens		
Provision	VMS, Website, SMS,	Expansion of those left	Expansion of those left
Method	E-Mail and Call Centre		
Traffic	Signals on the Road	- Expansion of those left	- Expansion of those
Control	VMS on the road	- Variable Lane System	left
Method		- Park & Ride Guidance	- ERP (Electric Road
		- Multi modal transport guidance	Pricing)
		- Parking information guidance	
	To be expanded in $2^{nd}$ and $2^{nd}$	3 <sup>rd</sup> phases in line with preparation of	of
	- Public & Lane Parking,	Public Based Multi Modal Transpo	rtations

 Table 9
 Master Plan Implementation Schedule

# 5 Financing Plan and Funding Scheme

# 5-1 Approximate Cost of Implementation by Phase

The approximate cost for the implementation by phase is shown in the Table below. Since technology advancement is very rapid and the factors for estimate such as the systems to be introduced in future are not clear now, the costs including the operation and maintenance are estimated only for Phases -1 and -2.

Cost Type	Items	PHASE 1	PHASE 2
Capital Cost	Equipment Capital Cost	1,10,36,00,000	3,22,40,00,000
Equipment	1 <sup>st</sup> stage Cost (10% of Capital	11,03,60,000	11,03,60,000
Maintenance Cost	Cost)		
	2 <sup>nd</sup> stage Cost (10% of Capital	0	32,24,00,000
	Cost)		
Cost spread	Equipment Maintenance Cost	33,10,80,000	1,51,90,00,000
across 5 years	Human Resource Cost	14,19,50,000	22,87,10,000
	Organisation Operation Cost	13,59,00,000	21,88,70,000
	Total Maintenance Costs	6,08,930,000	1,96,65,80,000

 Table 10
 Approximate Cost by Phase (Unit=INR)

The breakdown of the capital cost by phase is show in the Table below.

 Table 11
 Approximate Capital Cost by Phase

NT-	Destaur		PHASE 1		PHASE 2
INO.	Devices	Units	Approx Cost	Units	Approx Cost
1	ITS CENTRE		18,21,21,500		5,11,80,000
2	TRAFFIC SIGNALS	221	(HTRIMS) 0	179	1,10,51,26,000
3	PEDESTRAIN SIGNALS	0	0	400	48,84,00,000
4	TRAFFIC COUNTERS	68	15,03,04,000	170	37,27,90,000
5	CCTV	55	3,41,00,000	375	22,16,50,000
6	MET SENSORS	6	3,07,47,200	0	0
7	FLOOD SENSORS	14	1,29,80,000	111	10,08,70,000
8	VARIABLE MESSAGE SIGNS(VMS)	42	56,53,56,000	54	73,04,22,000
9	POLLUTION SENSORS	10	7,53,50,000	0	0
10	Subtotal		1,05,09,58,700		3,07,04,38,000
11	Contingency (Approx. 5% of Above Subtotal)		5,25,47,935		15,35,21,900
12	<b>Total Estimated Approx</b>		(1,10,35,06,635)		(3,22,39,59,900)
12	Cost		≒1,10,36,00,000		≒ 3,22,40,00,000

# 5-2 Economic Analysis

Economic analysis is carried out to estimate benefits brought by ITS and validate the implementation of ITS.

#### 5-2-1 Basic Conditions for Analysis

The basic conditions for the economic analysis are set out as follows:

- Target Years: 2015, 2020, and 2030
- Project Period: 20 years
- Target Area: Inside Outer Ring Road

#### 5-2-2 Methodology of Analysis

#### (1) Current and Future Traffic Demand Forecast

The effect of ITS is measured on how much the implementation of ITS contributes to alleviation of traffic congestion. Thus, the traffic demand in the year of 2011 is used as current demand data, and the future traffic demand for the years 2015, 2020 and 2030 is forecast on the condition of absence of ITS implementation, as the first step.

The current traffic demand is based on the result of current O/D and traffic volume survey and adjustment incorporating the existing relevant traffic data.

The future traffic demand is forecast by extending the current O/D, and applying the coefficient of extension obtained by the relevant existing data.

#### (2) Estimated Benefit of Three Cases: With and Without

The benefits for the following three cases, with and without for each case, are estimated. The benefits are expressed as monetary values in terms of saving travel time cost in USD per year.

- Case 1: Signal Installation (only): With and Without
- Case 2: Information Provision (only): With and Without
- Case 3: Signal Installation and Information Provision (combined): With and Without

#### (a) Signal Installation

It is presumed for the analysis that the signals are installed at the junctions of major roads in the city. The major roads include NH, SH, IRR and other major secondary roads.

#### (b) Information Provision

It is presumed for the analysis that realtime traffic information is provided to drivers, and the drivers become enabled to select an optimum route in the city.

In strict terms for estimating the benefit brought by ITS implementation, the evaluation of 'Information Provision' would be sufficient. However with and without cases of signal installation are also provided because the signal is one of the important factors influencing the traffic.

#### (3) Economic Evaluation: EIRR, NPV, B/C

The following three evaluation indicators are calculated based on the traditional Discount Cash Flow (DCF) method:

- Economic Internal Rate of Return (EIRR)
- Net Present Value (NPV)

• Benefit / Cost Ratio (B/C)





Source: JICA Study Team

Figure 11 Workflow of Economic Analysis

#### 5-2-3 Result of Economic Analysis

#### (1) Estimated Benefit

The benefits of three cases derived from with and without cases are estimated as shown in the table below. The results indicate positive impact for all three cases. Thus the implementation of ITS can be judged as effective.

Com	Benefit(Without	ut-With) Unit: M	illion USD/Year
Case	2015	2020	2030
1. Signal Installation	80	200	223
2. Information Provision	16	78	291
3. Signal Installation	25	117	215
& Information Provision	25	117	315
So	ource: JICA Study Te	am	

 Table 12
 Summary of Benefit

Note: The following notes are supplements to the above two, "case 2; Information Provision", and "case 3; Signal Installation and Information Provision".

- The ITS facilities for data collection and information provision will be introduced in steps. Furthermore, it is expected that road users who are able to receive the real-time traffic information generated by ITSC by such means as terminal devices will be gradually increased.
- In consideration of this, the availability of the real-time traffic information to the road users is adjusted respectively at 10% in 2015, 30% in 2020 and 50% in 2030.

#### (2) Economic Evaluation

The results of the economic evaluation for Case 3 are summarised below.

<b>Evaluation Indicators</b>	Values	Unit
EIRR	83.7	%
NPV	277.8	Mil USD
B/C	9.19	
Source: JIC	A Study Team	

 Table 5-13
 Result of Economic Evaluation for Case 3

It is concluded that the ITS implementation is economically feasible because of i) EIRR higher than opportunity cost of capital (>12%), ii) positive value of NPV (>0) and iii) B/C higher than unity (>1.0).

This is because ITS implementation does not require large-scale infrastructure development and has lower cost compared to general civil works such as road/bridge construction.

# **5-3** Financial Analysis

The Internal Rate of Return (IRR) was calculated based on the traditional discount cash flow method. The financial analysis was carried out for ITS proposed in phase-1. The following conditions were considered;

- Basic Conditions
  - ✓ JICA loan at 1.2% rate
  - $\checkmark$  10 years grace period
  - ✓ 30 years repayment period
- Expenditure
  - ✓ One time capital cost for ITS equipment in phase-1
  - ✓ Equipment replacement cost
  - $\checkmark$  Operation and maintenance cost
- Revenue
  - ✓ Mandatory Revenue:

Mandatory one time ITS user charge, assumed at INR 130 for 4-wheeler and INR 30 for 2-wheelers

✓ Optional Revenue:
 Selling traffic data, assumed at INR 50,000,000 per annum

The one time capital cost, which is ITS equipment in phase-1, is assumed to be funded by JICA loan. The equipment replacement cost consideres the expected life span of equipment. It is assumed by IT unit for 7.5 years, communication facilities for 15 years, electric facilities for 20 years and civil facilities for 30 years. The maintenance cost is assumed to incure 5% of initial cost every year after defect liability period for 2 years. The operation cost is due to human resource cost after commencement of operation.

It is assumed to collect a mandatory one time ITS user charge from 4-wheeler users at INR 130 and 2-wheeler users at INR 30 at the time of vehicle registration. This is on the assumption that the users pay the one-time charge for ITS as public service. The currently registered number of 4-wheelers

and 2-wheelers in Hyderabad and approximate forecasted growth rate for the next 30 years are considered.

As optional revenue for ITS in addition to the mandatory one time ITS charge, it was considered that the road and traffic information generated by ITS centre would be sold to public and private sectors for planning, marketing, etc. at INR 50,000,000 per year. The sales will start 5 years after commencement of operation of ITS centre, considering that the data which has commercial value may be generated after accumulation of data collection.

	Balance with Optional Revenue	Balance without Optional Revenue
IRR	21%	20%

 Table 14
 Financial Analysis Results

The result shows that 21% of IRR in case with optional revenue and 20% of IRR in case without optional revenue respectively.

# 6 Summary of Pilot Project

# 6-1 Design of Piloto Project

#### 6-1-1 Basic Policy of Pilot Project

In view of ITS under current condition, the major issues are summarised as follows;

- The current traffic conditions such as traffic flow and traffic volume are not correctly comprehended by road and traffic administrators.
- The appropriate planning and evaluations for traffic management and road infrastructure improvement are not objectively carried out because of absence of mechanism to utilise the quantitative and historical traffic data.
- Neither road administrators nor traffic agencies have very basic and important data and information.

There are a number of different ITS services and subsystems. However considering the current conditions in Hyderabad, a 'basic environment' which enables the above is mostly required for Hyderabad.

Thus, the pilot project aims to prepare the preliminary platform to realise as follows;

- To enable to comprehend the traffic conditions on the major roads in Hyderabad,
- To enable to comprehend the road conditions which are susceptible to hazardous weather,
- To enable to utilise the quantitative traffic data on historical bases for planning,
- To enable to provide the road/traffic information to the road users to divert the traffic, and
- To enable to properly coordinate with the related agencies including ORR ITS.

#### 6-1-2 Design Method Applied to Pilot Project

'Design Build' was applied to the design method for the pilot project, in consideration of the nature of ITS. Being different from the conventional project represented by civil construction, the system design and development constitute large proportion in the ITS project. The ITS project is generally characterised by i) information technology which rapidly advances on day-to-day basis, ii) many different methods to realise the required functions in terms of detail design.

In order for the employer, HMDA/HGCL, to avoid losing the opportunity to adopt the latest technology at the time of installation and to assure flexibility to adopt the most optimum method to realise the required functions, the consultant's design shall specify the required functions which need to be realised, by applying the method of the design build, instead of preparing the detailed design.

#### 6-1-3 Policy and Objectives of Equipment

#### (1) ATCC: Automatic Traffic Counters and Classifiers

#### (a) **Purpose**

ATCC will be used to comprehend the traffic volume and traffic flow on the major road in Hyderabad metropolitan area by measuring the vehicle speed and counting the cross-section traffic volume. The measured data will be utilised for traffic control and road management. It will be also utilised for traffic congestion information provision to the users.

#### (b) Installation Policy

ATCC will be insatlled in the middle of each section of the principal roads. The principal roads

include National Highway (NH-7, NH-9 and NH-202 within Hyderabad metropolitan area), IRR and State Highways (SH-1, SH-2, SH-4, SH-5 and SH-6). The section means the division between the junctions of these roads. It will become possible to measure the traffic condition by section by installing ATCC in accordance with this policy. These principal roads were selected because of the scale of the traffic volume in the Hyderabad metropolitan area.

One unit for one direction will be installed in the middle of the section to measure the traffic. Two units for both directions will be installed at the same location. The proposed location plan of the ATCC is shown in Figure 12



Figure 12 Location Map: ATCC

#### (2) FLD: Flood Monitoring Sensors

#### (a) **Purpose**

The drainage facilities are not sufficiently in place in Hyderabad. Thus the flood frequently occurs on the occasions of rain and it adversely affects the traffic flow in the city. The condition of the flood on the road needs to be properly comprehended by the road/traffic administrator. The historical data on the condition of the flood on the road will be utilised for road infrastructure improvement and information provision.

#### (b) Installation Policy

It was published by Traffic Police that there were 125 flood-prone areas in HMA. Amongst them, 14 locations were shortlisted as the most serious spots. Thus, these 14 locations were selected for the FLD by the pilot project.

The proposed location plan of the FLD is shown in the figure below.



Figure 13 Location Map: FLD

# (3) CCTV: Closed Circuit Television

#### (a) **Purpose**

In view of traffic management, visual confirmation of site condition by CCTV is imperative. Thus, CCTV will be installed by the pilot project.

#### (b) Installation Policy

Hyderabad and Cyberabad Traffic Police plan to install 334 CCTV at the junctions. Therefore CCTV by the pilot project will be intalled at the different locations as follows:

- They will be installed at the same locations with ATCC, which is between junctions, to visually monitor the actual traffic flows.
- They will be installed at the same locations with the flood monitoring sensors to visually confirm the water logging condition.

The proposed location plan of the CCTV is shown in the figure below.



Figure 14 Location Map: CCTV

#### (4) VMS: Visual Message Sign Board

#### (a) **Purpose**

The information collected by the above equipment will be provided to the road users in the form of warming message, information on the road/traffic conditions, etc. for the purpose of diverting the traffic. The auto-rickshaws and 2-wheelers are dominant mode of traffic in Hyderabad. Covering these modes by ITS is important issue from a local perspective. Thus, VMS was selected as one of the major media for information provision to cover all different traffic modes.

#### (b) Installation Policy

VMS will be placed at upstream locations before major junctions of the major roads in Hyderabad. This is for the purpose of diverting the traffic before major junctions on the occasion of traffic event. The major roads include IRR, NH (NH7, NH9, and NH202) and major radial roads.

- At upstream locations before major junctions of NH-IRR, NH-NH and IRR-Radial Road,
- At upstream locations before major junctions of Radial Road on the direction toward inside city, and
- At upstream locations before major junctions where the flood monitoring sensors are located ahead but not included above.

The locations on the directions toward outside city in outer stretch of the city are basically excluded. This is for the purpose of more focus on diverting the traffic concentrated toward the city in the pilot project as the phase-1.

Other than VMS planned by this project, the traffic police plans to prepare 17 sets of VMS under the H-TRIMS project. It is expected that some of VMS may be overlapped. However, these locations planned by the traffic police have not been identified yet. Thus, the number/locations of VMS prepared by this project may be further adjusted at the time of installation.



The proposed location plan of the VMS is shown in the figure below.

Figure 15 Location Map: VMS

#### (5) Bus Probe System

#### (a) **Purpose**

It is difficult to cover the entire area of Hyderabad metropolitan area for measurement of traffic by installing ATCC on the road side. Thus, the bus probe data will be utilised as means of collection of the traffic data. The advantage of the probe is that it becomes possible to measure area-wise traffic in the city. The congestion will be judged by the centre server.

#### (b) Installation Policy

APSRTC is planning to develop a bus location system by installing GPS on 1,350 city buses under JnNURM scheme. The probe data from the buses will be collected by their centre. The collected probe data will be transmitted to ITS Centre, which will be prepared by the pilot project, from their centre.

#### (6) MET: Meteorological Monitoring System

#### (a) **Purpose**

Meteorological system will be prepared to collect the data on weather conditions including rainfall, temperature, wind velocity/direction and etc on the roads in HMA transmitted from meteorological department, APSDPS. The collected weather information will provided to the road users, road administrators and traffic police, etc.

#### (b) Meteorological Data Collection

The meteorological conditions at approximately 60 locations in Hyderabad are being measured

by APSDPS. The measured data is transmitted from the meteorological measurement equipment to the meteorological server in APSDPS. It has been agreed between HGCL and APSDPS that the meteorological data collected by the Meteorological Server in APSDPS will be provided to the meteorological server of ITS Center.

### (7) ITSC: ITS Centre

## (a) **Purpose and Policy**

ITS Centre will be developed for central control. The proposed ITS by this project consists of many sub-system components. The ITS centre system manages the total system, data exchange between sub-system components to assure their functions and achieve the overall objectives of the proposed system as follows;

- To collect, manage and integrate all data related to the road and traffic conditions, incidents, weather conditions and other necessary data,
- To process, store and record the necessary data for effective road planning, operation and maintenance,
- To disseminate the collected and processed information to the road users in order to take notice of the traffic events and/or detour drivers' travelling route from the congested area or the hazardous area,
- To display and monitor the above collected and processed information on real-time basis, and share the information with the road planning agencies, road administrators and traffic police, and
- To totally manage the city ITS operation in the ITSC.

The ITS Centre will be prepared on the 2<sup>nd</sup> floor in the same building of the Outer Ring Road ITS, which will be newly constructed.

# (b) Internet, Web and E-Mail

The road and traffic information will be provided to the users by SMS and Website as well. This is for the purpose of traffic demand management, leading the optimum traffic behaviour of the road users by providing the information which is available other than VMS on the road.

# 6-2 Operation and Maintenance for Pilot Project

The requirement of operation and maintenance for pilot project was studied and prepared in the form of specification for operation and maintenance as part of tender document, 'The Employer's Requirements Part C: Operation & Maintenance Specifications'. The following clauses summarise the requirements for operation and maintenance for pilot project.

# 6-2-1 Purpose of Operation and Maintenance

The purpose of operation and maintenance for pilot project, referred as 'the City ITS', is to operate and maintain the City ITS and related facilities, assuring continuous operation for 24 hours a day and 7 days a year without interruption.

#### 6-2-2 Scope of Works

The works for operation and maintenance for the pilot project are listed below:

- (1) Monitoring of traffic on the Hyderabad metropolitan road network through CCTV and ATCC system
- (2) Monitoring of weather condition on road using Flood System and Meteorological System
- (3) Detection of incidents
- (4) Information dissemination through VMS and Internet
- (5) Monitoring and maintenance of equipment operation
- (6) Identification of the roles of operation and maintenance staff
- (7) Information exchange with other organizations concerned
- (8) Keeping operation and maintenance log

#### 6-2-3 Organisational Setup

In order to achieve the objective of the City ITS, proper organisation needs to be set up. Based on the discussion with HMDA, the organisation is proposed as shown in the figure below. The figure shows the proposed organisation structure of the City ITS for the pilot project. The arrows in the figure indicate the information flow.

The operation and maintenance team by the members of the contractor will be formulated under General Manager of HMDA.



Source: Prepared by JICA Study Team

#### Figure 16 Organisation Setup

#### 6-2-4 City ITS Operation

The operation of the City ITS is executed in accordance with the procedures as set forth and instructions given by HMDA. The system needs to be in operation 24/7 without interruption for the following subsystems:

- CCTV System
- Automatic Traffic Counter-cum-Classifier (ATCC) System
- Flood (FLD) System
- Meteorological (MET) System
- Schematic Map
- Probe System
- Variable Message Sign
- Security & Incident Management Service

## 6-2-5 City ITS Maintenance

The maintenance of the City ITS is executed in accordance with the procedures as set forth and instructions given by HMDA. The system needs to be in operation 24/7 without interruption for the following maintenance items:

- Preventive Maintenance
- Corrective Maintenance and Accident Repair
- Service Level Requirement

## **6-3** Preparation of Contract Documents

The following documents were prepared by the project for tender of the ITS pilot project:

- Tender Documents
- PQ Document
- Cost Estimation

#### 6-3-1 Tender Documents

The following documents along with pre-qualification document were prepared for tender of the ITS pilot project.

Volume	Description
Ι	Section I - Invitation for Tender (IFT)
	Section II - Instructions to Tenderers (ITT)
	Section III - Form of Tender
	Section IV - Pricing Documents
	Section V - Conditions of Contract Part I General Conditions (COC-GC)
	Section VI - Conditions of Contract Part II Conditions of Particular Applications
	(COC-PA)
II	Section VII - Employer's Requirements Part A General Technical Specification (GTS)
	Section VII - Employer's Requirements Part B Particular Technical Specification
	(PTS)
	Section VII- Employer's Requirements Part C Operation & Maintenance Specification
	(OMS).
III	Section VIII - Employer's Requirement - Drawings

Table 15Tender Documents

#### (1) **Basic Policy for Preparation of Tender Document**

#### (a) Referred Tender Document and FIDIC

It was agreed between HMDA/HGCL and JICA and confirmed with JICA study team that the tender document for the pilot project of this project, the City ITS, would be prepared based on the tender document for Toll Management System (TMS) and Hihgway Traffic Management System (HTMS) of Outer Ring Road (ORR) because of the following reasons;

- The City ITS is closely linked to TMS and HTMS of ORR
- HGCL is the employer of the City ITS, TMS and HTMS of ORR
- Procurement of equipment of the City ITS, TMS and HTMS of ORR will be funded by the

#### same JICA loan agreement

The tender document of TMS and HTMS of ORR was prepared based on FIDIC Orange Book which was published in 1995.

#### (b) **Operation and Maintenance**

Based on the request of HMDA/HGCL for inclusion of preparation of tender document for procurement of contractor for operation and maintenance, it was agreed between HMDA/HGCL and JICA and confirmed with JICA study team that the procurement of the contractor for operation and maintenance for a period of 5 years would be included in the same package of the City ITS. Thus the tender document of the City ITS was prepared including the portion of operatin and maintenance.

The cost for the equipment of the City ITS will be funded by JICA loan, 'Hyderabad Outer Ring Road Project (Phase 2), ID-P198'. The cost for the operation and maintenance for a period of 5 years will be funded by HGCL.

#### (c) Scope of Contract for Contractor

In regard of all above, the scope of contract for contractor of this project was set out as 'Design, Supply, Installation, Testing, Commissioning, Training, Warranty and Remedying Defects of Equipments and Related Facilities of Hyderabad City Intelligent Transport System (Hyderabad City ITS) in the state of Andhra Pradesh, India being taken up with the loan of assistance of Japan International Cooperation Agency under Phase-2 program and Operation and Maintenance of Hyderabad City ITS and Related Facilities a separate fund provided by Hyderabad Growth Corridor Limited for a period of five years'.

#### (2) Tender Document Volume I – Contract Document

The contract documents were prepared based on the policies described above. The 'Section V – Condition of Contract Part I General Conditions (CoC-GC)' is based on FIDIC Orange Book.

#### (3) Tender Document Volume II - Technical Specification

The technical specifications were prepared based on the design of the pilot project. The requirements which are commonly applicable to the technical specification are described in the 'Section VII - Employer's Requirements Part A General Technical Specification (GTS)'. The technical specification of each ITS sub-system are described in the 'Section VII - Employer's Requirements Part B Particular Technical Specification (PTS)'.

#### (4) Tender Document Volume II – Operation and Maintenance Specification

The requirements and specifications for operation and maintenance for a period of 5 years are described in the Volume II – Operation and Maintenance Specification. The requirement of service level to meet, Service Level Agreement (SLA), is one of the most important aspects for HGCL. Thus, the requirements and specifications for operation and maintenance were prepared on the basis of SLA.

#### (5) Tender Document Volume III - Drawings

The drawings were prepared for reference purpose.

# 6-4 **Pre-Qualification Document**

The pre-qualification documents were prepared based on the criteria required for City ITS.

# 6-5 Cost Estimation

The project cost was estimated based on the configulation of the pilot project. The result of the cost estimation is as shown below.

#### Table 16Estimation of the Pilot Project

Iotal Estimation Cost (INK)
-----------------------------

1,62,00,00,000

# 7 Road Inventory Survey

# 7-1 Purpose of Road Inventory Survey

The purpose of the road inventory survey is to prepare a road inventory application which visually shows the inventory information of the major roads in Hyderabad.

One of the major issues in transport sector in Hyderabad is that neither HMDA, which is a planning agency, nor GHMC, which is a road administrator, hold basic information on the road such as road structures, facilities, etc. The drawings of the roads are not available, either. Such situation is causing difficulties in carrying out a proper road maintenance and management. Futher, the situation is not limited to Hyderabad and many cities across India are in a similar condition.

In Japan, the road inventory is maintained by road operators/administrators and utilised for road maintenance and management. It is also used as important source for planning of road improvement. Concerning this, a road inventory application for Hyderabad was prepared by this project, as a pilot bases, to contribute to improvement of management and planning of the road.

# 7-2 Prepared Road Inventory Application

The road inventory application provides basic inventory information such as road name, road class, width, etc. together with the picture of site condition and map of road network in Hyderabad. A sample image of the application is shown below. The map on left shows the road network. The road classification on the road network is indicated by different colour in accordance with Indian Road Congress (IRC) guideline.

The picture on upper-right shows the image of site condition which was captured by driving recorder. It provides both static pictures and moving images along with the corresponding locations of the road on the map of the road network. The table on middle-right provides basic inventory information pertaining to the corresponding road section.

The user can select the road section to show the inventory information and image of the site condition by clicking the location on the map. The pane on buttom-right allows the user to select the road class to show on the road network on the map.



Source: Prepared by JICA Study Team

Figure 17 Visualising Road Inventory Image (Road Inventory Tool)

# 8 Capacity Building Programme

# 8-1 ITS World Congress in Vienna

The study includes the capacity building for HMDA officials through workshops, study tours and the on job training to gain knowledge and experience of ITS. The participation in the 19th ITS World Congress in Vienna in 2012 was carried out as a part of the capacity building programme. It was intended to gain and reinforce the knowledge on ITS through preparation of the paper, making presentation on the Congress and extend the knowledge through the opportunities of being exposed to the world-wide ITS practices and meeting the practitioners of ITS in the World. The paper was prepared jointly by the officials of HMDA and JICA Study Team members and awarded by the committee of the ITS World Congress for presentation.

HMDA Commissioner Mr. Prasad presented on 23rd at "Policy & Strategy" session (TS008).



Source: JICA Study Team Figure 18 Presentation Session

The ITS World Congress is an annual event which showcases the latest ITS solutions in the world, provides an excellent platform to exchange information and share knowledge of international best practices of ITS amongst the stakeholders, decision and policy makers in the world. The theme of 2012 ITS World Congress was "Smarter on the way" with "the goal that all citizens and businesses have at all times access to, and can benefit from, the most reliable, efficient and widespread intelligent mobility solutions". The ITS Congress was attended by more than 10,000 participants from 91 countries including 3,000 delegates and 2,500 visitors. The ITS exhibition had a share of 304 companies from 33 countries including 23 technical demonstrations.

# 8-2 ITS Technical Tour in Japan

The technical tour to Japan is another capacity building programme, aiming to contribute building close relationship between India and Japan. It was carried out in middle of February 2013 to provide the important key officials in India with an opportunity to experience the practices of ITS implemented in Japan and broaden knowledge on the technologies and operations of ITS.



Source: JICA Study Team
Figure 19 Presentation Session

# 9 Conclusion and Recommendation

## (1) Outline

Memorandum of Understanding (MOU) for the Project was exchanged between Huderabad Growth Corridor Limited (HGCL) under Hyderabad Metropolitan Development Authority (HMDA) and Japan International Cooperation Agency (JICA) on the 28th April in 2011.

Consultancy services for the Project were provided, through grant support of JICA, for the purpose of contributing to alleviate congestion in Hyderabad Metropolitan Area.

The Project aims to assist the Andhra Pradesh State Government and Hyderabad city authorities to improve the traffic through formulating ITS Master Plan for Hyderabad Metropolitan Area and implementing the prioritied ITS services in a phased manner. Thereby, the traffic will be properly controlled and diverted, leveraging the road and transport network including radial roads and Hyderabad Outer Ring Road (ORR) which are under construction by JICA loan project.

JICA procured the consultant, a joint venture consisted of Nippon Koei Co., Ltd., East Nippon Expressway Co., Ltd. and Metropolitan Expressway Co., Ltd. in July 2011. The consultant commenced the project in August 2011 and officially submitted the Final Reaport together with ITS Master Plan for Hyderabad Metropolitan Area and a whole set of the tender document of the pilot project for the prioritied ITS services in February 2014.

HGCL/HMDA, the counterpart of the Project, continuously provided sincere support and cooperation throughout the Project, formulating Technical Advisory Committee consisted of a number of Indian stakeholders concerned.

We hope that the ITS Master Plan will contribute to improvement of urban traffic, thereby development of Hyderabad and the pilot project be smoothly implemented as the first ITS in India.

#### (2) Basic Concept of Master Plan in Regard of Current Condition in Hyderabad

The major issue in Hyderabad is that the traffic is not objectively comprehended. For example, the junction names and areas that are chronically congested are known to people. But these are based on people's general experiences. The traffic in the city is monitored by CCTV in the existing traffic control centre by traffic police. However the objective of CCTV is visual confirmation of site condition. It is important that the traffic condition is quantitatively perceived as to where, when and how much it is congested. The cumulated historical data and information needs to be utilised for the measures of improvement of road transport infrastructure and traffic management.

In consideration of such situation, the basic policy of ITS Master Plan was set out to prepare a basic environment to quantitatively measure the traffic condition and cumulate the data in ITS Centre. The data to be collected includes travel speed, spot traffic volume, flood condition and weather information because these are considered as basic important information that the road and traffic authorities need to have. It aims realtime monitoring on traffic and utilisation for proper planning and evaluation of measures for road transport infrastructure and traffic management, by cumulating the collected data in ITS Centre. It also aims to properly regulate the traffic flow by providing realtime traffic information through VMS installed at the critical locations. Moreover, the traffic information generated by ITS Centre is aimed to be used as one of the revenue sorces by selling to the interested parites in public and private sectors.

#### (3) Probe Data of Andhra Pradesh State Road Transport Corporation

Utilisation of probe data obtained from Andhra Pradesh State Road Transport Corporation

(APSRTC) is proposed as the major data collection method in phase-1 of ITS Master Plan. APSRTC is planning to develop bus location system. The vehicle location data measured by GPS installed on bus will be transmitted and utilised for measurement of vehicle speed in ITS Centre. The reason is that sufficient number of other modes of road transport is not available. For example, there are many auto-rickshaws in the city. However they are not appropriate for measurement of vehicle speed due to lower speed than other vehicles. The private taxies are equipped with GPS. However they are not sufficient in number, and realtime transmission to ITS Centre would be difficult because of various reasons such as their policies of confidentialily, etc.

Data collection is most important factor for ITS. The data collection of ITS Centre will be heavily dependant on the probe data from APSRTC due to above reasons. Therefore, assuring that the probe data be shared by APSRTC is critical for the ITS project. It was agreed with APSRTC by the letter that the probe data would be shared by APSRTC. It is emphasized that continuous close coordination with APSRTC needs to be ensured and memorandum of understanding be exchanged between HMDA and APSRTC for smooth implementation of ITS.

#### (4) Meteorological Data of Andhra Pradesh State Development Society

Utilisation of meteorological data obtained from Andhra Pradesh State Development Society (APSDPS) is proposed for weather monitoring in phase-1 of ITS Master Plan. It was originally considered to install the meteorological measurement sensors in the city by this project for monitoring weather conditions such as precipitation. However it was confirmed that APSDPS was measuring the weather by their existing facilities and that APSDPS would share their data. The weather data will be transmitted on-line from their servers to the ITS Centre..

It was agreed with APSDPS by the letter that the space for equipment for data transmission in their premise would be provided and necessary software modifications of their system would be taken care by APSDPS. It is emphasized that continuous close coordination with APSDPS needs to be ensured and memorandum of understanding be exchanged between HMDA and APSDPS for smooth implementation of ITS.

# (5) Data Collection from Highway Traffic Management System of Hyderabad Outer Ring Road

Highway Traffic Management System (HTMS) for Hyderabad Outer Ring Road (ORR) will be developed and the tender was called in December 2013. It was concluded that the ITS Centre proposed by ITS Master Plan will be developed in the same building of Traffic Control Centre (TCC) of HTMS. The ITS Centre will monitor the traffic in the city, and HTMS will monitor the traffic on ORR. The traffic information will be provided to the users by combining the information of HTMS and ITS Centre. The ITS Centre will obtain the traffic information from HTMS such as traffic regulation, road closure, road works, VMS information being provided, etc.

Necessary arrangement is required for both sides of TCC of HTMS and ITS Centre to realise this. For example, the different contractors will be procured for HTMS and ITS Centre. The contractor of HTMS can not make software arrangement of ITS Centre. The employer for both projects is Hyderabad Growth Corridor Limited (HGCL). Thus, proper arrangement needs to be made by the initiative of HGCL for smooth implementation of the projects.

#### (6) Necessity of Efficient Implementation of Pilot Project

ITS services proposed by ITS Master plan in phase-1 will be implemented as a pilot project. The basic design and tender documents were prepared by this project. The major issues for

implementing the pilot project are i) limited period for installation which is eighteen (18) months, ii) many installation locations for various equipment in the city and iii) a number of involved parties such as Hyderabad Metro Rail Corporation (HMR), traffic police, Greater Hydeabad Municipal Corporation (GHMC), etc. In order to ensure timely implementation of the pilot project, a) submission of the detail desing by the contractor and approval of the employer in timely manner, b) assuring site acquisition for installation of equipment, c) coordination amongst involved parties are critical. A strong initiative of HGCL as an employer is necessary.

### (7) Traffic Signals

The traffic signal is important for city traffic. The improvement of the traffic signals is proposed in phase-2 in the ITS Master Plan. The reason is that replacement of the existing signals and installation of new signals are underway by traffic police under the project called HTRIMS. However the intersection improvement is not included in HTRIMS. In addition, the spaces for the pedestrian are not properly developed in the city, and there are not sufficient signals for pedestrian. Considering the current condition in the city, signal replacement needs to be implemented along with the improvement of the intersection and the signals for pedestrian.

## (8) Involvement of Traffic Police

Involvement of traffic police is important for ITS operation. The traffic control centre of traffic police is currently in operation. Thus, ITS Master Plan proposes that the ITS Centre will be developed at the different location from the existing traffic control centre. The ITS Centre will be attended by personnel of traffic police in phase-1, and the operation and systems will be integrated with traffic police in later stage. The traffic police raised concerns that confidentiality of the collected data on traffic by the ITS Centre needs to be ensured and provision of traffic information be controlled by the traffic police in regard of security.

The data to be collected and information to be provided by the ITS Centre in phase-1 is limited to the traffic. However when integrated with the traffic police in the later stage, the issues such as handling of VIP movement need to be dealt together with the traffic police. Thus, the policy for involvement of the traffic police and coordination with them towards integration for later stage needs to be set out. It is recommended that such policy be formulated and agreed at state level such as Unified Metropolitan Transport Authority (UMTA).

# (9) **Operation of ITS Centre**

ITS Centre will be operated by the contractor under HMDA in phase-1. However, the long-term concept of the ITS Centre proposed by ITS Master Plan is to have holistic functions as a single agency including planning, promoting and managing ITS. A variety of related agencies such as Greater Hyderabad Municipal Corporation (GHMC), Hyderabad Growth Corridor Limited (HGCL), HMDA (Hyderabad Metropolitan Development Authority), AndhraPradesh State Road Transport Corporaion (APSRTC), National Highway Authority of India (NHAI), Transport Department, etc will have to be inevitably involved. It is strongly recommended that continuous efforts in coordinated, integrated and holistic manner be made towards establishment of full-fledged ITS Centre for Hyderabad, together with all involved parties.

#### (10) Coordination with Traffic Police for VMS Installation

VMS on the road side is proposed by the pilot project. Meanwhile, VMS is also planned by traffic police under HTRIMS project. The study team tried to confirm the locations of the VMS

planned by HTRIMS during the basic design stage. However these locations were not confirmed because that these locations had not been identified yet. Thus, some of the locations of VMS planned by both projects may be duplicated. It is necessary to make adjustment of the numbers and locations of VMS to be installed by this project once the contractor is procured.

#### (11) Coordination with Other Departments for Installation of Roadside Equipment

The proposed roadside equipment by the pilot project are automatic traffic counter-cum (ATCC), flood sensors (FLD), CCTV and VMS. CCTV will be installed at the same locations of ATCC and FLD. FLD will be installed on the flood-prone locations based on the information published by the traffic police. The numbers and locations of the roadside equipment were confirmed by HGCL with the relevant authorities such as Hyderabad Metro, GHMC, NHAI, etc. However it is expected that procurement of consultant and contractor for the pilot project may take certain time. Further, tt may take more time for installation of the roadside equipment considering the required time for other activities such as detail desing by the contractor, approvals by the employer, etc. It is assumed that the surrounding road conditions will have changed by the time of installation. Therefore, final confirmation in regard of the locations and number of the roadside equipment is required again by the initiatives of HGCL with all related authorities.

## (12) Incorporation of ITS Master Plan into Comprehensive Transport Plan in Hyderabad

A comprehensive transport plan, called CTS, is underway in Hyderabad. Meanwhile, ITS Master Plan was prepared by this project. The factors considered by CTS were reflected in ITS Master Plan. However, as ITS is one of soft measures in transportation sector, it would deserve to consider incorporating ITS Master Plan into the comprehensive transport plan in Hyderabad.

#### (13) Traffic Information of Google and New Technology

The Google Co., Ltd. is offering the congestion information in Hyderabad. The information is provided based on the location data collected through Android smartphone users. It is assumed that such congestion is judged by the travel speed based on the data which is identified as vehicle movement amongst different modes of traffic such as walking, cycling, etc. The study team requested them to utilise the data collected and cumulated by the Google for the ITS Centre. However their reply could not be obtained, presumably due to their policy of confidentiality. This implies that vast amount of traffic data that they hold can not be utilised. It is possible to simply show the congestion information offered by the Google on the map in ITS Centre, for example. But it is not possible to process and analyse their raw data. This is the situation as of February in 2014. However their current policy may not be necessarily remain the same forever. Furthermore, advancement of information technology is very fast. The new technology which is not available now may appear in the near future. Thus, the attention always needs to be paid to the prospect of availability of Google data and other new technologies for ITS in Hyderabad.

#### (14) Necessity of Revise of ITS Master Plan

ITS Master Plan was prepared by phase-1 for 5 years, phase-2 for 10 years and phase-3 after 10 years, and it shows the ITS services to be introduced by phase. However information technology advances very rapidly. It can be assumed that new ITS services which do not exist now may become available after 5 years. Furthermore, ITS needs to be planned and developed in accordance with situation of traffic and road/transport infrastructures. The condition of traffic and the development status of road/transport infrastructures will be changed in the near future. Therefore, ITS Master Plan

shall be continuously revised.

#### (15) Necessity of Infrastructure Improvement

ITS is one of soft measures and traffic congestion can not be alleviated only by ITS. The investment for infrastructure is necessary. For example, there are not sufficient alternative routes in Hyderabad. Even though the realtime traffic information is provided by ITS, there are not enough options for the road users to detour in the current situation. Currently, Outer Ring Road is under development and some radial roads are being improved. In addition to these roads, it is important that the road infrastructures be more improved. The examples include, development of more alternative routs in the city, grade separation of major junction, parking facilities, pedestrian footpaths, widening of Inner Ring Road, etc. Hyderabad metro is under construction. Development of area in front of/near station is also required such as parking bay for smooth transition between different traffic modes. Then, the movement of people will become different once such infrastructures are developed. ITS needs to be re-considered along with planning of transport and infrastructure.