JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF INDIA

Special Assistance for Project Implementation (SAPI) for Hyderabad ORR Project Phase I

Final Report Summary

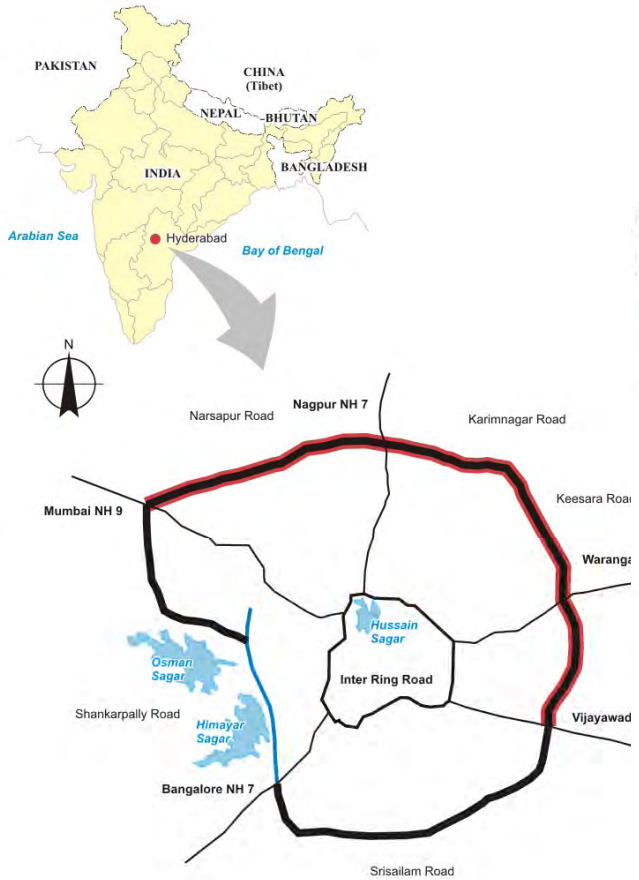
May 2009

ALMEC Corporation

NEXCO East Ltd.

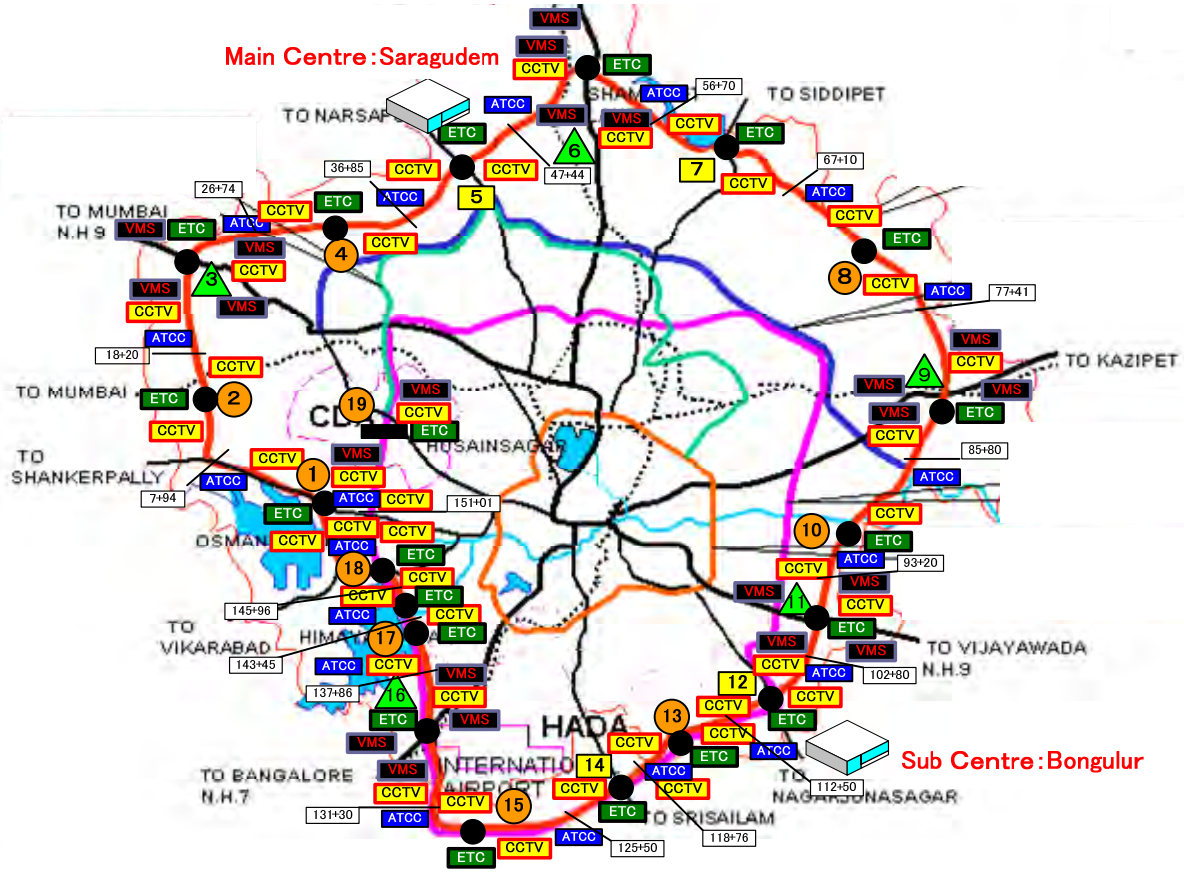
Value Planning International, Inc.

Overall ITS Development Plan of the Hyderabad Outer Ring Road Project



Outer Ring Road Alignment

Phase 1		24.38 km	State Government of AP
Phase 2A		62.30 km	PPP (BOT Annuity)
Phase 2B		71.30 km	JICA Loan
TOTAL		**157.98 km**	



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ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ADT	Average Daily Traffic
AP	Andhra Pradesh
APRDC	Andhra Pradesh Road Development Corporation
ARIB	Association of Radio Industry and Businesses
ATCC	Automatic Traffic Counters-cum-classifier
BOT	Build Operate Transfer
CALM	Continuous Access for Long and Middle
CBD	Central Business District
CCD	Charge-coupled Device
CCTV	Closed-circuit Television
CEN	European Committee for Standardization
CGM	Chief General Manager
CMU	Corridor Management Unit
DPR	Detailed Project Report
DSRC	Dedicated Short Range Communication
ECB	Emergency Call Boxes
EOI	Expression of Interest
EPC	Engineering Procurement and Construction
ETC	Electric Toll Collection
GHMC	Greater Hyderabad Municipal Corporation
GHz	Giga Hertz
GNSS/CN	Global Navigation Satellite System / Cellular Network
GOAP	Government of Andhra Pradesh
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HGCL	Hyderabad Growth Corridor Ltd.
HMA	Hyderabad Metropolitan Area
HMDA	Hyderabad Metropolitan Development Authority
HTMS	Highway Traffic Management Service
HUDA	Hyderabad Urban Development Authority
HUMTC	Hyderabad Unified Metropolitan Transport
ICB	International Competitive Bidding
ICT	Information Communication Technology
IEC	International Electrotechnical Commission
IIT	Indian Institute of Technology
INCAP	Infrastructure Corporation of Andhra Pradesh
ITS	Intelligent Transport System

ITU	International Telecommunication Union
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
LCV	Light Cargo Vehicle
MAT	Multi-Axle Truck
MCH	Municipal Corporation of Hyderabad
MRTS	Mass Rapid Transit System
MSRDC	Maharashtra State Road Development Corporation
NHAI	National Highways Authority of India
NHDP	National Highway Development Program
O&M	Operation and Maintenance
OBU	On Board Unit
O-D	Origin and Destination
OFC	Optical Fiber Cable
OMT	Operation, Maintenance and Transfer
ORR	Outer Ring Road
PMC	Project Management Consultant
PPP	Public Private Partnership
RFID	Radio Frequency Identifier
RFP	Request for Proposal
ROW	Right of Way
RSU	Roadside units
SAPI	Special Assistance for Project Implementation
SEZ	Special Economic Zone
SMS	Short Message Service
SPV	Special Purpose Vehicle
TCC	Traffic Control Center
TMS	Tolling Management Service
TOR	Terms of Reference
VICS	Vehicle Information and Communication Service
VMS	Variable Message Signs

1 Introduction

Project Background

In December 2005, the State Government of Andhra Pradesh established a special purpose vehicle (SPV) for the ORR project, Hyderabad Growth Corridor Ltd. (HGCL) which receives equity from two public organizations under the state government: Infrastructure Corporation of Andhra Pradesh (INCAP, 26%) and Hyderabad Metropolitan Development Authority (HMDA, 74%). The company negotiated with a consortium of domestic banks and obtained a long-term loan of Rs.5 billion by mortgaging the lands held by HMDA to carry out phase I of the ORR project. Regarding Phase II-A covering 62.30 km from Narsingi to Patanchru and from Shamshabad to Pedda Amberpet, five concessionaires were selected through international competitive bidding (ICB) under the BOT-annuity model. For Phase II-B, two loan agreements were made between the Government of India and JICA in March and November 2008.

The first JICA loan package, amounting to 41.8 billion yen, includes construction work (38.0km of the ORR and its associated roads), consulting services, and HIV/AIDS prevention. The second package, amounting to 42.0 billion yen, encompasses construction work (33.3km of the ORR, its associated roads, and intelligent transport system or ITS to support the entire ORR), consulting services, and HIV-AIDS prevention.

Study Objectives

The study aims at assisting the implementation of the Hyderabad ORR project, focusing on ITS. More specifically, the study's objectives are three-fold:

(i) To concretize ITS services for efficient and integrated operation and maintenance of the Hyderabad ORR;

(ii) To coordinate concerned organizations and agencies to achieve the above objective, including, but not limited to, interchange design for ETC, real-time information provision to road users, and ITS-related O&M body; and

(iii) To support the effective implementation of the proposed ITS during the Yen-loan Project Phase II, particularly ITS-related bid procedure and documents.

2 Project Appreciation

2.1 Legal Basis and Project Scheme

Legal Basis

By virtue of the provisions contained in Articles 294 to 296 of the Constitution of India the states have been allowed to assume the properties and assets of the former Governor's Provinces and the erstwhile Indian States. Thus the responsibility for developing and maintaining roads in the country other than national highways, such as state highways and other roads, falls on the state government or the local authorities in the state where the concerned roads are situated.

In relation to urban areas, the State of Andhra Pradesh has enacted the Andhra Pradesh Urban Areas Development Act 1975 and created the Hyderabad Urban Development Authority (HUDA) as a separate corporation with the following mandate, among others: preparation of a master plan and the integrated planning and development of Hyderabad's urban areas. Later on, the Hyderabad Metropolitan Development Authority (HMDA) Act was enacted in 2008 (Act No. 8 of 2008) for serving larger jurisdiction by 3.7 times than that of the former HUDA.

The state government likewise recognized the need to provide for the rapid development of infrastructure as well as attract private sector participation through the enactment of the Andhra Pradesh Infrastructure Development Enabling Act (Act No.36 of 2001). This resulted in the establishment of the Infrastructure Corporation of Andhra Pradesh Limited (INCAP) as a wholly owned company of the Government of Andhra Pradesh. Under its charter, INCAP is authorized, among other things, to promote special-purpose vehicle (SPV) companies to develop infrastructure.

The HGCL has been promoted by INCAP and the erstwhile HUDA as a SPV to implement the government's proposal to develop the outer ring road (ORR) along with the satellite townships in and around Hyderabad. The HGCL is a corporate body having a common seal and perpetual succession. It has powers to acquire, hold and dispose of properties, borrow loans, and mortgage its properties. INCAP and HUDA signed a memorandum of understanding to provide for the shareholding of their rights and obligations in implementing the HGC Project.

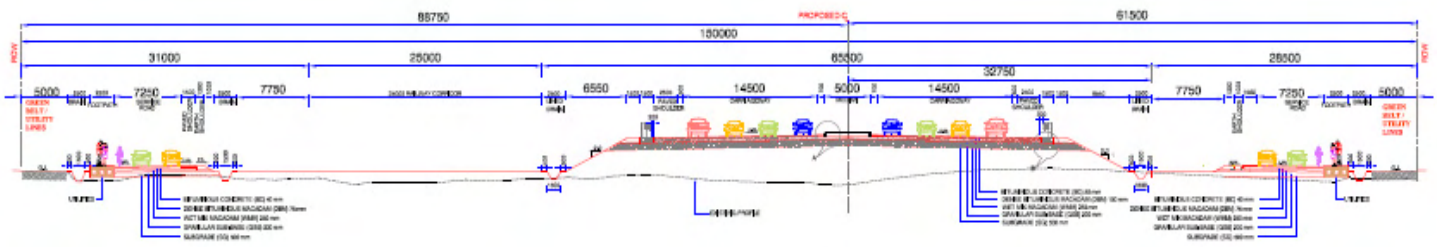
Project Scheme

The ORR has an 8-lane divided carriageway with full access control in addition to service roads on both sides and a railway. The overall right of way is 150m wide at most of its total aligned 158km.

In terms of construction and financing, the entire ORR stretch is divided into three phases:

- Phase I – The section from Gachibowli to Shamshabad (24.4km) is being financed by loans from a consortium of banks. HGCL has arranged two (2) contract packages both of which should have finished by the end of 2008 originally and by January or February 2010 under the modified schedule as of April 2009 ;
- Phase II-A – The sections from Narsingi to Patancheru and from Shamshabad to Pedda Amberpet (62.3km in total) will be carried out under a BOT scheme wherein, the concessionaire will provide the initial financing required to construct the road, while the HDMA/HGCL will pay the concessionaire in 25 annuity payments over a specific period of time in addition to 20% of the project cost upfront as grant to the concessionaire. HGCL has arranged five (5) contract packages. The concession agreements were concluded in August 2007 while the construction works are scheduled to be completed by May or June 2010 ;
- Phase II-B – The section from Patancheru to Padda Amberpet via Kandlakoya, Shamirpet, and Gha will tap ODA funding from JICA. The Japanese yen loan has a low and fixed interest rate (i.e. 1.2%) with a long-term repayment period (i.e. 30 years) inclusive of a 10-year grace period. The construction works will be completed by the end of 2011.

Figure 2.1 Typical Cross-section of the Hyderabad ORR



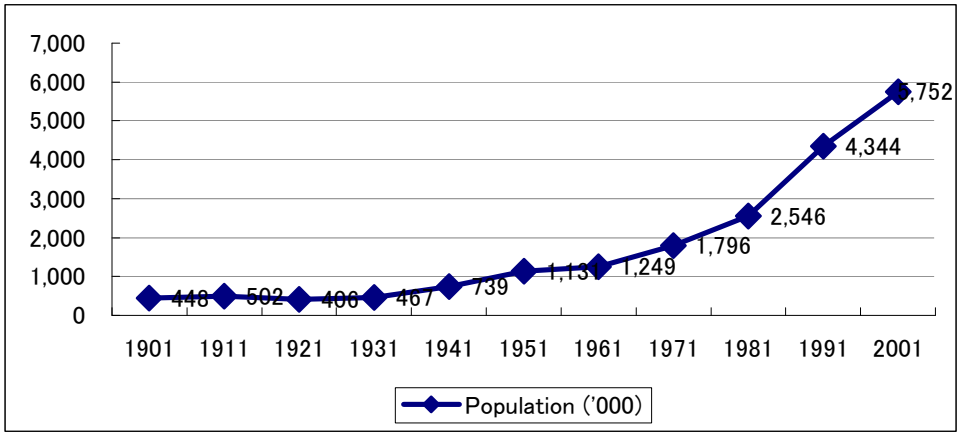
Source: HGCL

2.2 Hyderabad ORR under Metropolitan Development

Demography Urban population data are available even prior to the formation of HUDA in 1975. Data show a continuous growth from 406 thousand in 1921 to 5,752 thousand in 2001. A sharp urban growth trend reaching 2.3 times was observed between 1981 and 2001.

The Draft Master Plan for Hyderabad Metropolitan Area: "Hyderabad 2020" has a population projection for HUDA, i.e. 9.1 million by 2011 and 13.6 million by 2021. The population in HUDA increased from 2,993 thousand in 1981 to 6,383 thousand in 2001 at an annual growth rate of 3.85%. An almost similar rate (3.87%) is expected until 2021.

Figure 2.2 Population Growth in Hyderabad's Urban Areas, 1901-2001



Source: Hyderabad 2020, HUDA 2003

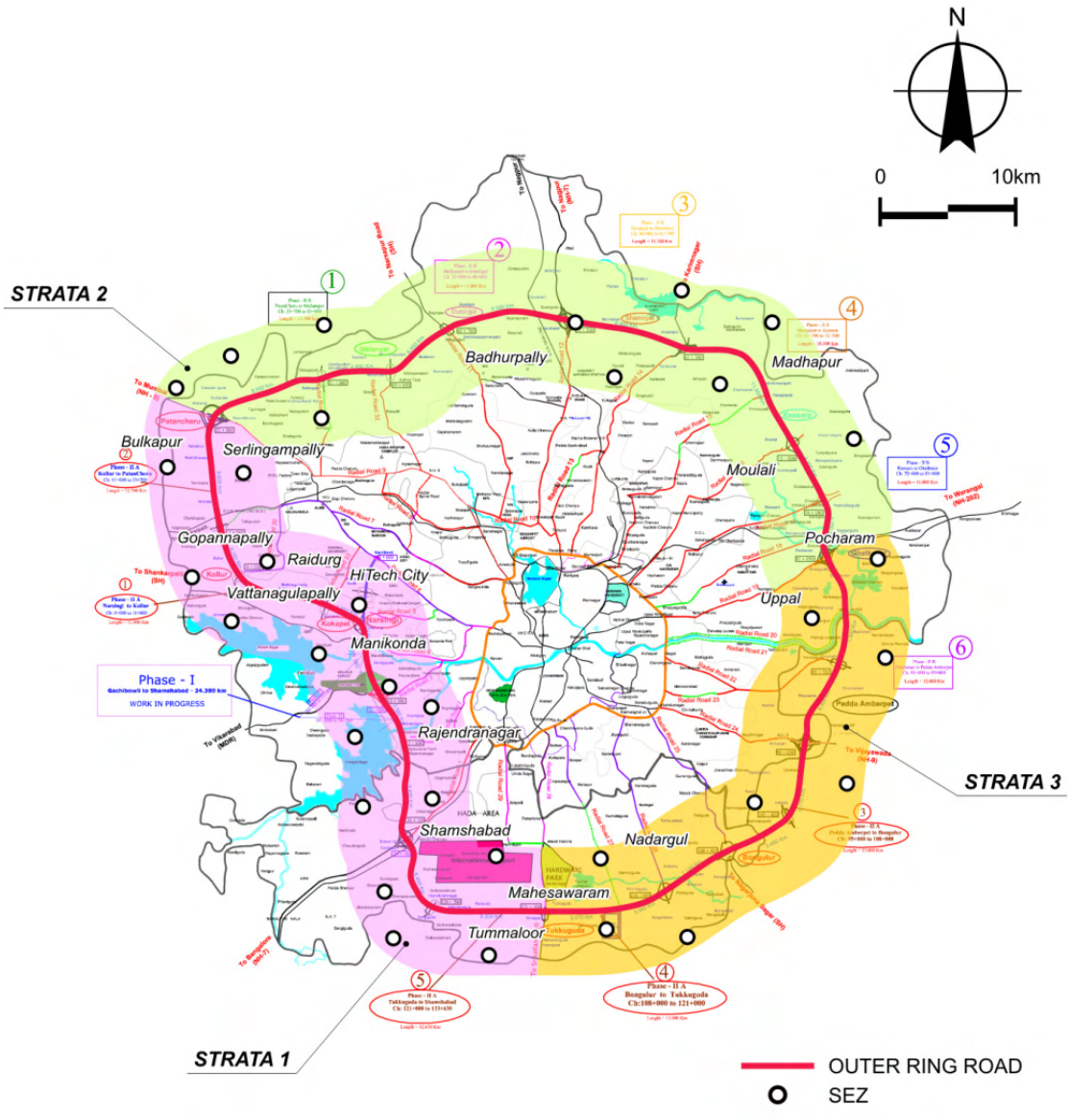
Vehicle Ownership Motorization in Hyderabad is high. The number of registered vehicles jumped from 0.6 million in 1993 to 1.4 million in 2002, or a 10.6% increase annually. It has a much faster pace than population growth. During the same period, all kinds of private vehicles registered sharp increases.

The number of vehicles per 1,000 residents substantially increased from 116 vehicles in 1993 to 218 vehicles in 2002. Compared with advanced Asian cities such as Tokyo and Seoul, vehicle ownership in Hyderabad has already reached the 200 and 300 vehicles per 1,000 resident ownership range. However, Hyderabad differs from these cities in vehicle composition; two wheelers are dominant in Hyderabad with a 78% share, while four wheelers are dominant in Tokyo and Seoul with two wheelers taking minor shares.

Recent Corridor-wide Development

Provided that the ORR Corridor is defined within 5 km from both the sides of ORR, the Corridor has a population of 1.5 million in 2007. The population has grown by 3 times since 1981. The ORR Corridor has newly received 703 establishments between 1996 and 2007. 613 of which were established during the second half of the period (2002-2007). There are 34 special economic zones (SEZ) at the Corridor, 18 SEZ assisted by the public sector and 16 SEZ developed by the private sector. 25 of all 34 SEZ intend to attract IT and IT enabled services. These data clearly show that the ORR Corridor is literally a growth corridor in Hyderabad.

Figure 2.3 Location of SEZs along the ORR Corridor



2.3 Analysis of ORR Traffic Demand

Existing Traffic Demand

The ORR project provides strategic functions in metropolitan development, i.e. alleviating traffic congestion in the Hyderabad CBD by diverting traffic from the radial roads to the Hyderabad ORR and generating developmental traffic from newly built industrial estates, research parks, and satellite towns under a polycentric urban structure. However there is no existing traffic since the ORR is mainly a new alignment.

The DPR Consultant conducted the traffic count survey at 12 radial road points near the ORR alignment in 2006. The results are summarized as follows:

- The aggregated average daily traffic (ADT) volume is 182,645 vehicles.
- 5 national highways accounted for 102,154 vehicles or 56% of the surveyed traffic. Similarly, 5 state highways shared 35%.
- Cars were not the most popular vehicle type. 9 survey points recorded 2-wheeler as the largest type in terms of vehicle number. .

Road Users' Survey

The SAPI Study conducted road user's survey in January 2009 to understand road users' perception on the Hyderabad ORR. Major findings are summarized:

- The respondents by car and truck gave positive perception on the future usage of the ORR, showing over 84% on the average.
- On the other hand, their O-D patterns show that most of trips concentrate on the city center as departure or destination points. Therefore likely diversion traffic from the national highways to the ORR due to shorter travel distance, around 15% at best.
- The respondents are willing to pay to the ORR operator by Rs 20 and above. The thickest payment range by car users is Rs 30 while truck users Rs 40. Very large vehicles over 3-axle are willing to pay above Rs 60.

Table 2.1 Willingness-To-Pay for ORR Usage

Vehicle Type/Toll Amount	Willingness to Pay for Using ORR							Total
	Rs. 10	Rs. 20	Rs. 30	Rs. 40	Rs. 50	Rs. 60	Above Rs. 60	
Car/Jeep/Van/Taxi	1	75	310	213	53	68	105	825
%	0.12%	9.09%	37.58%	25.82%	6.42%	8.24%	12.73%	100.00%
Mini-Bus	0	4	10	25	13	10	11	73
%	0.00%	5.48%	13.70%	34.25%	17.81%	13.70%	15.07%	100.00%
LCV	2	25	162	158	44	90	91	572
%	0.35%	4.37%	28.32%	27.62%	7.69%	15.73%	15.91%	100.00%
2-Axle Trucks	8	116	420	589	209	277	364	1,983
%	0.40%	5.85%	21.18%	29.70%	10.54%	13.97%	18.36%	100.00%
3-Axle Trucks	1	57	337	518	162	336	592	2,003
%	0.05%	2.85%	16.82%	25.86%	8.09%	16.77%	29.56%	100.00%
Multi Axle Trucks	0	12	40	43	37	70	100	302
%	0.00%	3.97%	13.25%	14.24%	12.25%	23.18%	33.11%	100.00%

Source: Interview Survey by JICA SAPI 2009
Note: The most popular tariff zone is shaded.

Review of the ORR Demand Forecasts

There are two available documents showing the ORR's traffic forecasts: One was done by the DPR consultant for the ORR project and the other was done by IIT Chennai. Forecasts done by the two experts were made under different purposes, base data, and methodology, although they served the same client, HUDA.

Both the two documents did not analyze daily ORR capacities. However, it is necessary to examine allowable traffic demand on the ORR's main carriageway. The SAPI suggests that the ORR's main carriageway has 120,000 pcu in daily capacity:

ORR Main Carriageway Capacity = (Hourly Capacity x No. of Lanes) / Peak Hour Rate
(1,500 x 8) / 0.10 = 120,000

Taking the above into consideration, the DPR for the ORR project projected excessive traffic demand. By 2021, it predicted that six of the 12 sections would carry larger traffic volumes than the capacity of 120,000 pcu/day, requiring 10 or 12-lane carriageways. On the other hand, IIT Chennai's projection is rather moderate in light of the ORR's infrastructure capacity. By 2021, it predicted that traffic demand on the five sections would exceed 50,000 pcu/day, requiring a 6-lane carriageway.

Generally, ITS planning works are undertaken to meet demand 10 years ahead. The SAPI Study adopts the traffic demand forecast by IIT Chennai for ITS planning.

2.4 Review of ORR Civil Works

Toll Collection System

Toll road operations have a basic principle: fewer toll plazas mean easier operation. Thus in designing interchanges for toll expressways, it is very important to minimize the number of toll plazas. It is proper for the HGCL to have chosen a closed system for the ORR since the ORR is a long-distance urban road with potential for additional toll road networks in the future. It could also mean the installation of toll plazas at the ramps of the interchanges.

Interchange Design Concepts

In the DPR, two interchange designs were applied: a cloverleaf type for major interchanges and a combination of rotaries and diamonds for minor interchanges. In some developed countries including Japan, either of these types is rarely used in urban toll roads. The basic reason being that both designs require large tracts of land, necessitating various toll gates.

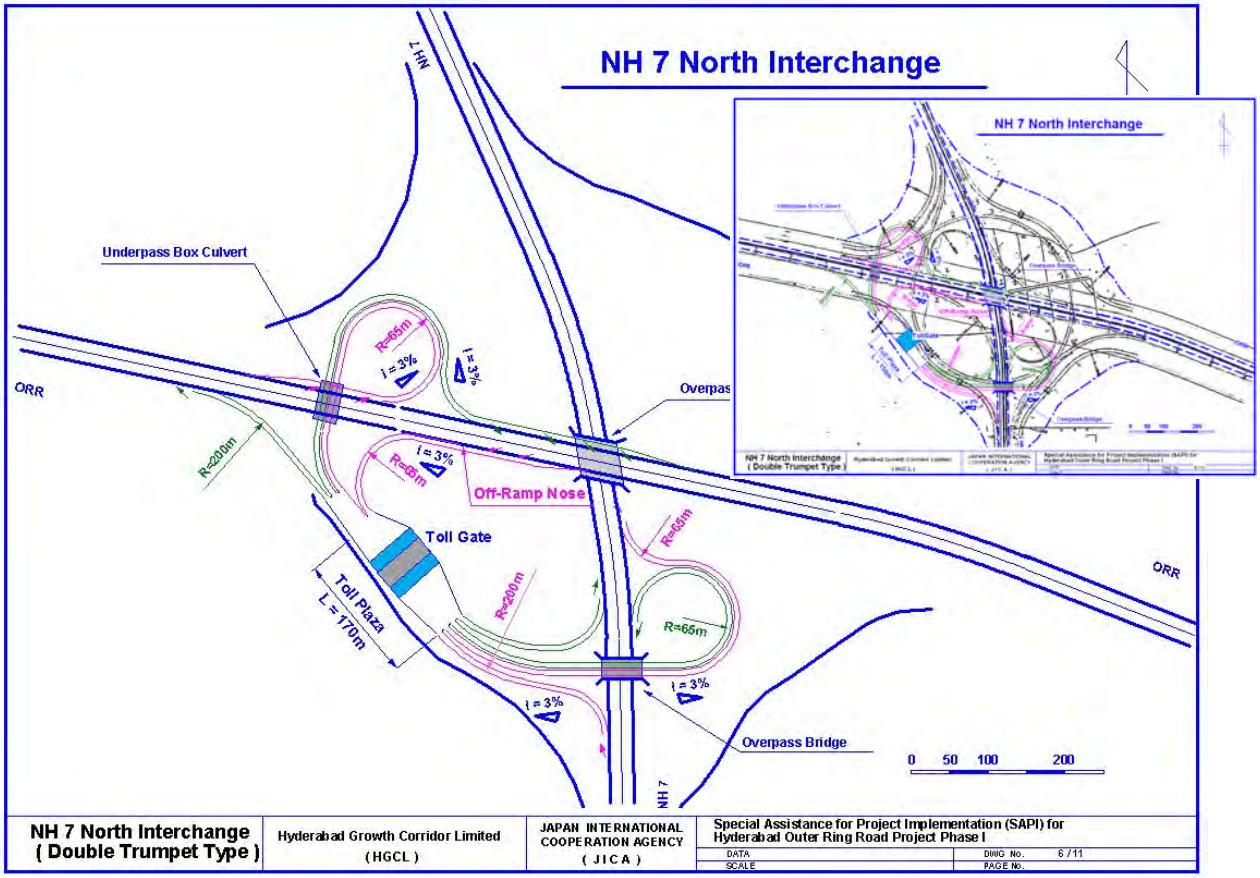
The SAPI Team modified all large interchanges across the national highways, except for the NH7 South Interchange at Shamshabad due to time constraint, from the original “Cloverleaf type” interchanges into a “Double trumpet type” (refer to Figure 2.4). 5 more large interchanges across the state highways were also modified in design by local consultants under the supervision of the SAPI Team.

Such modifications can allow the development of one integrated toll plaza. This will greatly benefit both the road operator and users through: (i) efficient operation and maintenance; (ii) higher security; (iii) quick response to various kinds of troubles and emergencies; and (iv) allows lesser numbers of toll booths.

Indicative Construction Cost Variation

At the same time, those modification works bring about one positive side effect or reduction in construction cost. This is because the double trumpet design requires smaller space and shorter ramp way in comparison with the original cloverleaf design. The construction cost variation has been analyzed indicatively based on ramp length and bridge structure. At the safe side, it may be said that construction cost reduction by 1/3 likely happens (refer to Table 2.2). It is also noted that a trumpet-type interchange requires about half of the land which accommodates a cloverleaf-type interchange.

Figure 2.4 One Example of Interchange Design Modification Works



Note: The insert shows the original interchange design.

Table 2.2 Construction Cost Variation at Selected Interchanges

		Ramp Length (m)	Difference	Bridge Area (m2)	Difference	Cost Variation
NH7-North (Medchal)	Original	6,830		7,530		
	Double Trumpet	2,955	-3,875	6,100	-1,430	-35%
NH7-South (Shamshabad)	Original	6,088		7,135		
	Double Trumpet					---
NH202 (Ghatkesar)	Original	6,770		6,420		
	Double Trumpet	2,821	-3,949	6,030	-390	-30%
NH9-East (Amberpet)	Original	6,635		7,876		
	Double Trumpet	2,600	-4,035	6,070	-1,806	-38%
NH9-West (Patancheru)	Original	7,900		16,499		
	Double Trumpet	2,943	-4,957	8,552	-7,947	-52%

3 ITS Development Plan

3.1 Early ITS Practitioners

Benefits of ITS Development

Intelligent transport system (ITS) is a concept with many technological innovations, enabling safer, faster and more enjoyable driving and thus ITS development greatly benefits all transport stakeholders including users, operators and administrations. ITS has been evolving continuously and the system development progress varies among cities and countries. Taking the project nature, e.g., toll expressway, and the locality into account, the section highlights 3 ITS related intermediary tools between the car driver and the external traffic environment: the electronic toll collection (ETC) system, the car navigation system and the vehicle information and communication system (VICS).

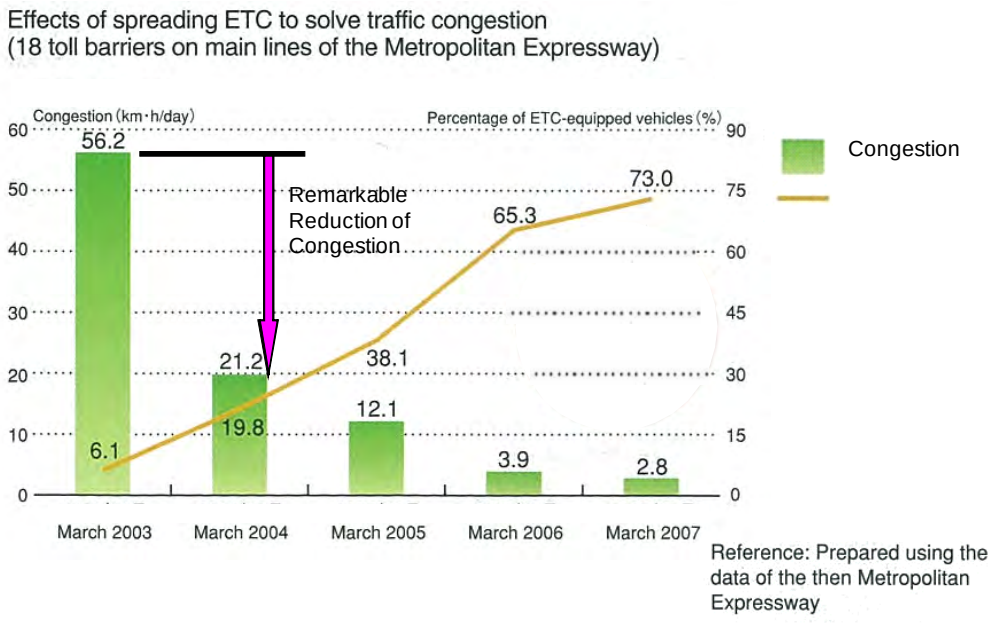
Japan's Experience

A car navigation system is a satellite navigation system designed for use in automobiles. It typically uses a GPS navigation device to acquire position data to locate the user on a road in the unit's map database. In addition to basic location service, various services have been provided for assisting safe driving such as "detection service of zigzag driving" and "notification service of curves ahead".

VICS is a digital data communication system which promptly provides the latest road traffic information to drivers via the car navigation system. The world's first VICS service started in Japan in 1996. VICS, using 5.8 GHz DSRC, can transmit various and large-volume information quickly. The services are provided in an adequate manner such as network image, still image by roadside camera and warnings by voice, making drivers understand easily.

Non-stop toll collection is a branch of Highway Traffic Management System, aims to eliminate congestions and delays of the flow in toll roads. Japanese ETC system is standardized nationwide, consisting of microwave DSRC (5.8 Ghz) with active OBU. Today, ETC users account for over 75% among all toll road drivers. Japan's experience shows that the rate of OBU-equipped vehicles significantly affects traffic congestion in toll plazas, i.e., substantial congestion alleviation if over 20% of vehicles have OBUs (refer to Figure 3.1).

Figure 3.1 Impacts of Using ETC System on Traffic Congestion



Source: ITS Japan Handbook 2006-2007

ETC Practices

The SAPI introduced many ETC practices worldwide in total 25 countries. They are classified into 6 types: (i) OBU-based identification system, (ii) wireless tag and CCD camera, (iii) wireless tag and GPS, (iv) CCD camera only, (v) Satellite based system and (vi) smart card.

The Next Generation ITS

One major international standardization initiative for the automobile ETC is CALM (Continuous Access for Long and Middle) range technologies in accordance with the ISO TC 204 WG 16. The scope of CALM is to provide a standardized set of air interface protocols and parameters for medium and long range, high speed ITS communication using one or more of several media, with multipoint and networking protocols and upper layer protocols.

The next-generation ITS services will be provided through a combination of ITS OBU, roadside units, satellite and road-vehicle communication where one integrated OBU is workable. Some services are either in practice or in trial in Japan. They include:

- Vehicle information and communication service
- Information for assisting safety driving
- Information for local traffic conditions,
- Compact interchanges dedicated for ETC users, and
- Various cashless payment services

3.2 ITS Development Strategies

Management Strategy - *"Integrated Operation and Management"*

The Hyderabad ORR is divided into 3 schemes. For Phase I and II-B, EPC contractors are responsible for O&M for 2 years immediately after the construction is completed. On the other hand, Phase II-A requests BOT concessionaires to undertake road O&M for 7.5 years and possibly extend this O&M contract or in total 15 years.

Even though ordinary road O&M could be done by the above schemes, O&M for ITS should be integrated under one body. There are mainly two reasons.

- Real-time road infrastructure and traffic information should be shared under traffic control center (TCC) for service efficiency. For real-time and sizeable information transmission, optical cable fiber is desirable to be installed along the ORR.
- Integrated toll collection in ring road configuration is advantageous when setting a uniform tariff structure with some discounting services compared with piecemeal tolling management.

Technology Strategy – *"Basic and Upper-system Compatible"*

There are rich opportunities to provide various advanced ITS services in Hyderabad while local needs are quite uncertain because of almost no ITS service have not been experienced among local motorists. The SAPI Study suggests that ITS services in Hyderabad be developed from basic to advanced ones gradually. Compliance to international standardization is a key to ensure this service upgrading way. In other words, economic solution covering basic services only is not recommendable to avoid duplicated investment in the future.

3.3 ITS Development Components

Review of the Original HTMS

The BOT contracts between HGCL and five concessionaires include the Highway Traffic Management System (HTMS) to be deployed by the BOT concessionaires. HTMS is composed of 6 elements: (i) Emergency Communication System, (ii) Mobile Communication System, (iii) Variable Message Sign System, (iv) Meteorological Data System, (v) Automatic Traffic Counter-cum-classifier System, (vi) Power Supply System.

The SAPI reviewed the original HTMS and resultantly changed their specifications and quantities.

Additions to HTMS

In addition to the revised HTMS, the SAPI has added the following subcomponents:

(1) Traffic Control Center (TCC): The TCC is the hub that controls and manages all the ITS services and orchestrates patrol and rescue operations. The TCC collects and analyzes various ORR operations, as well as information and data from the ECBs, CCTVs, ATCCs, and the meteorological data system. The TCC should analyze the collected information and data as quickly as possible and provide accurate information to road users through VMSs, internet, and SMS, and coordinate necessary actions with the traffic police, fire brigade, and other public organizations during accidents and emergencies (refer to Figure 3.2).

Taking the 158km alignment into account, the main and sub TCCs should be deployed correspondingly, with the main TCC at the Saragudem IC for the northern part and the sub TCC at the Bongulur IC in the southern part.

(2) CCTV: CCTVs are required for monitoring traffic flow through TV monitors. This system enables the TCC to see current road situations and to control the camera remotely by zooming and rotating them. However, surveillance through CCTVs requires a certain intensity of luminance. Therefore, IC areas are optimum locations for installing CCTVs since all interchanges are planned to have lighting.

(3) Internet Service/SMS Center: Using the Internet as a tool for providing road information to road users is practical and convenient. The TCC should also be equipped with an automatic SMS reply facility to enable road users to send SMS inquiries and receive automatic replies about road conditions on the ORR.

Toll Collection

It is appropriate that three modes of toll collection system to be installed. The first is an electric toll collection system (ETC), which enable the cars to pass with gate-bar lifting. The second is touch & go using pre-paid contactless IC-card. The third mode is manual (by collectors).

A vehicle using ETC lane must be equipped with an OBU (onboard unit) where an ETC card is installed at the OBU slot. The appropriate standards of the ETC card are contactless and it, is usable for touch & go too for OBU non-using drivers by scanning the cards over the RFID reader at the toll gate.

Figure 3.2 Image of TCC Operation for Advanced HTMS

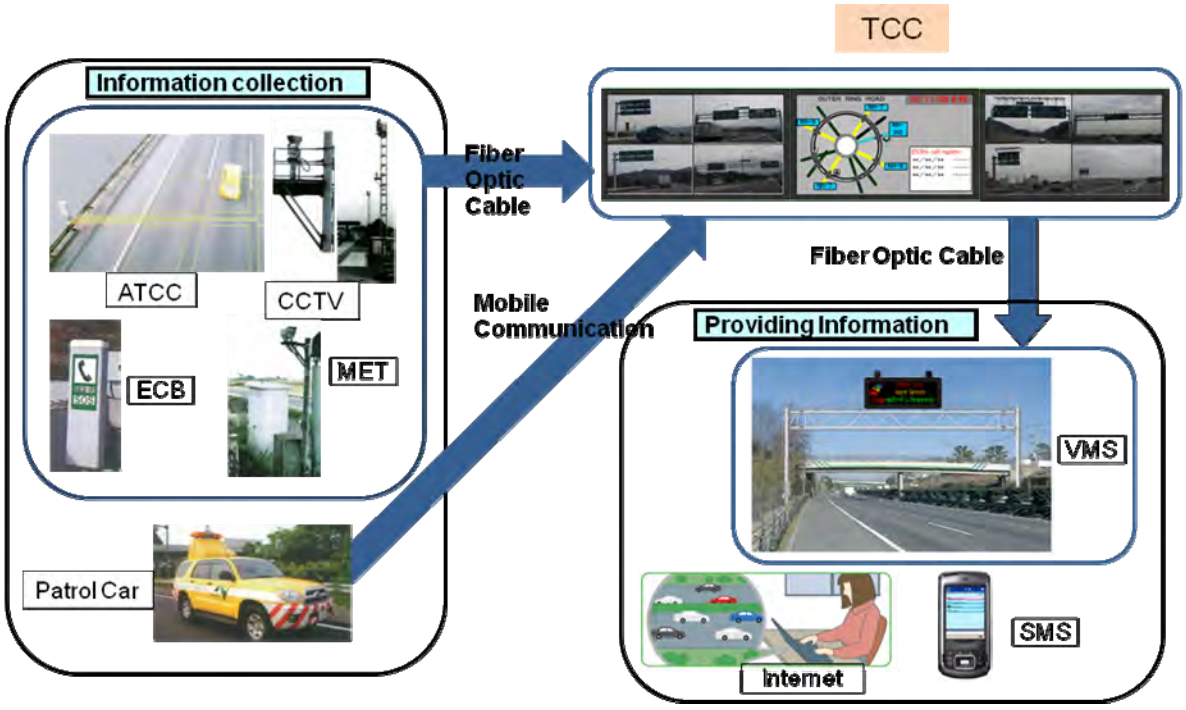
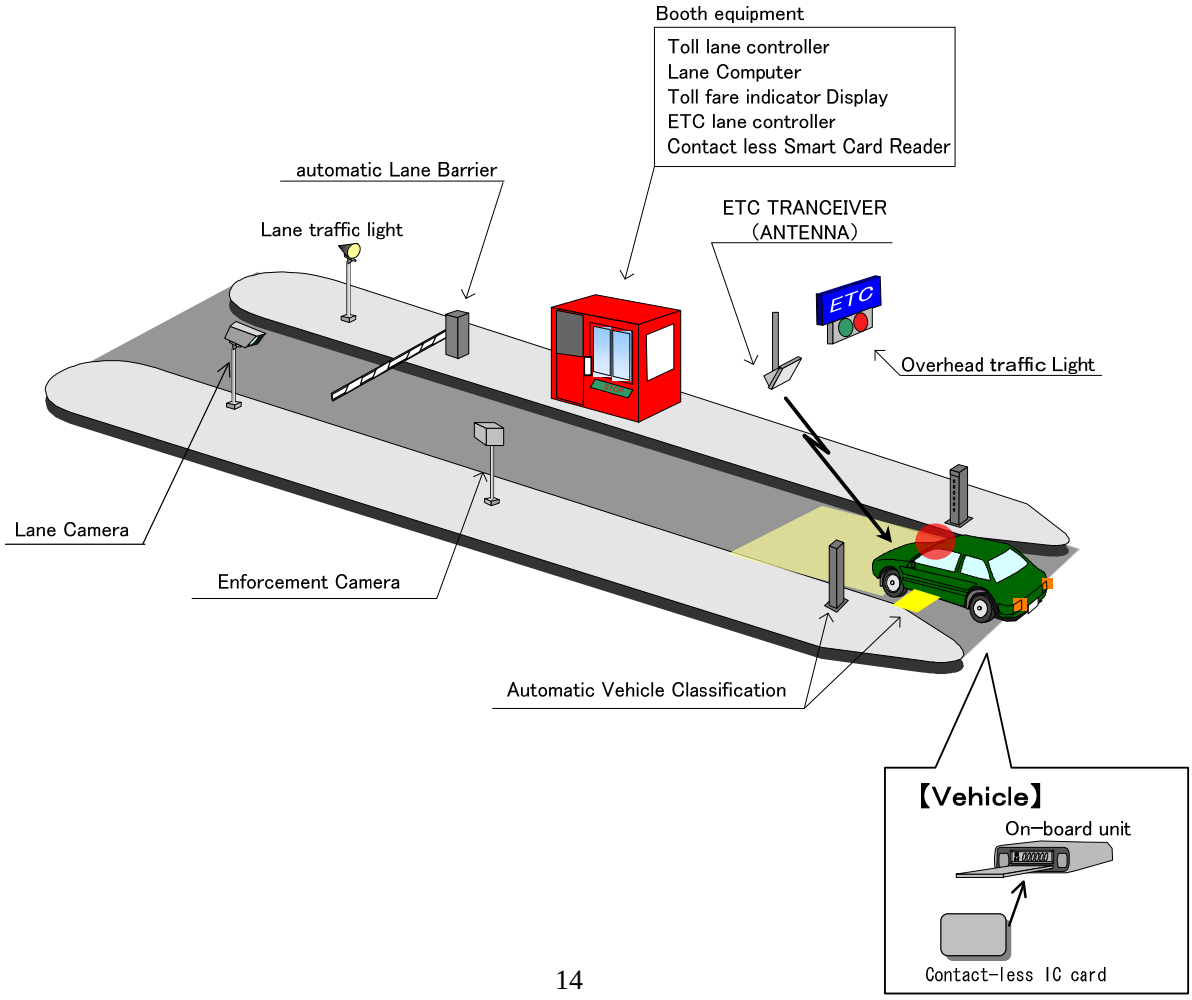


Figure 3.3 Image of Non-stop Tollgate System



3.3 ETC Technology

In regard to OBU-based identification, there are broadly 3 ETC technologies available. The SAPI compared them as summarized below. In conclusion, the microwave DSRC active system or so-called "global ETC" was selected due to high system performance and rich future upgrading opportunities.

The infrared system is affected by weather conditions, and by dusty air and dirt on vehicle windows. No legal protection and a monopolized manufacture are other concerns. The microwave DSRC passive system cannot meet the project design, an integrated OBU with smart card.

Table 3.1 Comparison of ETC Technologies

	Infrared DSRC	Microwave DSRC Passive	Microwave DSRC Active
System Performance and future upgrading	• It is relatively weak in certain weather conditions, such as heavy rain and fog. • It can use for free flow toll system but one antenna cannot be available for multi lanes. • Integrated use with Touch & Go is possible if the IC card is usable also for the OBU. • IC card should contain the purse data. • As there are no legal restrictions, personal data cannot be secured.	• Integrated operations with Touch & Go smart card is not possible because IC card contains ID numbers only and fee transactions are conducted by network and server side. • It cannot use for free flow since the range is too short. • High security since its frequency is protected by law.	• It has not been used in India. • Integrated use with Touch & Go is possible if the IC card is usable also for the OBU. IC card should contain the purse data. • It can use for free flow system up to 3 lanes by one antenna. • High security since its frequency is protected by law.
Adopted Areas	Malaysia, India (Noida)	European Countries, India (Gurgaon)	Japan, USA, Korea, China
Manufacturers	Efkon (Austria)	Many, including Kapsh	Many
Production of the equipments in India and other factors	Possible, but infrared components must be provided from a specific manufacturer.	Possible. OBU is most inexpensive and handy because it requires no electric sources.	Possible. Future expandability for Intelligent Transportation System could be promising. Price of the OBU is a bit more expensive than that of infrared.

Note: Compared by SAPI Team

3.4 Cost Estimates

The total project cost is estimated at 4,211 million Japanese Yen excluding project management consultant fee (152 million Japanese Yen).

Table 3.2 Summary of the ORR-ITS Project Cost

	Amount (INR)	Amount (Yen)
HTMS		
Emergency Communication System	82,000,000	172,200,000
Variable Message Sign Boards	242,000,000	508,200,000
Meteorological Data System	3,400,000	7,140,000
Automatic Traffic Counter Classifier	114,000,000	239,400,000
Traffic Control Center	43,800,000	91,980,000
Fiber Optic Cable & Installation Cost	360,000,000	756,000,000
Preliminaries & Provisions	227,600,000	477,960,000
Sub-total	1,072,800,000	2,252,880,000
CCTV System	65,600,000	137,760,000
Toll Collection System		
Cash + T&G Lanes	201,195,500	422,510,550
ETC Lanes	76,260,000	160,146,000
PLAZA LEVEL	137,220,000	288,162,000
SOFTWARES	124,072,000	260,551,200
CABLING WORKS	8,145,000	17,104,500
CCTV	51,720,000	108,612,000
Preliminaries & Provisions	227,600,000	477,960,000
Sub-total	826,212,500	1,735,046,250
Network & Power		
Fiber Convertor Box	90,500	190,050
Media Convertor	4,344,000	9,122,400
Layer 3 Switch	5,068,000	10,642,800
Generator(40KVA)	11,250,000	23,625,000
Uninterruptable Power Supply (UPS)	20,000,000	42,000,000
Sub-total	40,752,500	85,580,250
Grand Total	2,005,365,000	4,211,266,500
Project Management Consultant Service		151,937,000

Note: Exchange rates: Rs 1.0 = JPY 2.1

4 ITS Bidding and Procurement

4.1 Preparation of ITS Bidding

ITS Contracts

To execute the project smoothly, a broad knowledge of various kinds of ITS equipment are required because their task does not only cover design and supervision but also the examination of the quality of equipment and connectivity. The contractor has to cooperate with various suppliers for the design, importing, and installation of equipment. Contractors should be divided into two: one for advanced HTMS equipment and another for tolling management service (TMS) equipment. This is due to the following reasons:

- There are very few companies who can supply both the advanced HTMS and TMS solutions with satisfactory track records; and
- Since the work involved in equipment procurement and installation is huge and in order to implement the project on schedule, it would be advantageous to divide the overall work into two contracts.

Under the Phase-2 Yen Loan Agreement, a project management consultant (PMC) will be hired. The 3 contracts will be made through international competitive bidding (ICB) while the contract duration is 15 months from October 2010.

ITS Bidding Documents

The bidding documents for both the advanced HTMS and TMS can share the same contents, as follows:

- Section I Notice Inviting Tender
- Section II Instructions to Bidders
- Section III General Conditions of the Contract
- Section IV Special Conditions of the Contract
- Section V Scope of Work
- Section VI Technical Specifications
- Section VII Bill of Material and Formats for Submission of Proposals
- Section VIII HGCL Approved Bank Guarantee Formats

For assisting the bidding, the SAPI Study drafted sections V and VI for both the contracts which must not allow technical discrepancy in the specifications proposed in “3. ITS Development Plan”.

PMC Procurement

For PMC employment, a set of documents are needed for the Request for Proposal (RFP). The RFP usually contains the following:

- Section 1. Letter of Invitation
- Section 2. Information to Consultants
- Section 3. Form of Contract
- Section 4. Terms of Reference (TOR)
- Section 5. Forms of Technical Proposal
- Section 6. Forms of Financial Proposal
- Section 7. List of Eligible Source of Countries of Japan ODA Loans

The SAPI Study drafted the TOR where a team of key experts (international and domestic consultants), sub-professional staff and field staff is required. The TOR illustrates 3 main tasks as follows:

- Task 1: Supervision of ITS equipment installation;
- Task 2: Preparation of ITS operation and management manual; and
- Task 3: Provision of ITS training programs

4.2 Advice on ITS Bidding and Procurement Procedure

HTMS Bidders

The SAPI has advised eligibility/pre-qualification criteria and technical proposal criteria. Both the criteria, past experience of firm in executing similar ITS is a fact of utmost importance. More specifically, the experience is defined to have installed variable message sign boards, emergency communication boxes, automatic traffic counter-cum-classifiers, CCTV road surveillance and fiber optic network.

TMS Bidders

The SAPI has also advised eligibility/pre-qualification criteria and technical proposal criteria on selecting a TMS supplier. Both the criteria, past experience of firm in installing and maintaining ETC equipment and supply of toll lanes are highly appreciated.

PMC Candidates

Although this contract does not require pre-qualification in accordance with the JICA's procurement principle, a short-listed procedure is adequate in order to hire capable and experienced consultant internationally. A short-list will be made based on the submission of an Expression of Interest (EOI).

Technical proposals will be evaluated using a set of criteria with suggested weights, including firm's experiences, methodologies, work plans, and staffing. The minimum technical score required is over 75.

5 ITS Organizational Setup

5.1 Creation of New Organization

Institutional Arrangements

Regarding the legal basis for tolls collection on roads and bridges, the Andhra Pradesh State Government is empowered to collect tolls under the provisions of the Indian Tolls Act (1951) and the Constitution of India. It is legally understood that the HMDA is authorized to collect tolls in the ORR from its mission of development and maintenance of infrastructure in the Hyderabad metropolitan area, and, in particular, to recoup constructions costs, ORR maintenance, payment of annuities to the Concessionaires, and repayment of loans borrowed by the Government and its agencies on behalf the ORR Project.

It is not clear whether the HGCL is authorized to be responsible for operation and maintenance including tolls collection on behalf of the HMDA, although HUDA (now the HDMA) transferred the mandate relating to the implementation of the ORR to the HGCL on the basis of a MOU dated October 30, 2006. The proposal of the ITS organizational/institutional set-up under the HMDA was made in the SAPI study.

The SAPI Team and HMDA/HGCL also agreed on the importance of coordination among BOT concessionaires in Phase IIA and among EPC contractors to secure HTMS-ITS consistency in maximizing ORR project benefits. The HGCL needs to amend existing contracts with the BOT concessionaires for the amendments/modifications of the ITS-related operation, management and maintenance in their respective concessionaire contracts and also if necessary carry out amendments/modifications in any other clauses of the Concession Agreement and the EPC Contract.

In addition, the HMDA should closely coordinate with relevant agencies, including the police department and other relevant departments under the strong initiative of Hyderabad Unified Metropolitan Transport Committee (HUMTC), for the successful operation and management of the proposed ITS-related entity described in 5.2 below.

Public-private Partnership

The Central Government of India encourages the introduction of efficient operational and maintenance system, and based on the government policy the NHAI is undertaking the operation and maintenance of existing completed highways through operation, maintenance and transfer (OMT) basis. This OMT policy is followed in some states such as Maharashtra.

The SAPI Study examined the policy and its practices by Maharashtra State Road Development Corporation and Madhya Pradesh Road Development Corporation Limited. It concludes that the OMC policy is applicable to the ORR ITS project. Without utilizing external resources, a new organization to be established under HMDA for ITS must be huge. A tolling unit alone requires at least 1,500 personnel at 19 interchanges under a 24-hour/3-shift working system.

5.2 ITS Operation and Management Body

Mission and Tasks

The integral mission of the ITS organization under the HMDA is to develop and ensure a safe and effective transport system through standardized controls and management procedures along the entire the ORR under the PPP encouragement program by applying modern technology on operation and management. Based on the mission on ITS-related tasks mentioned above, the role is divided into two (2) areas: one is for the HTMS and another is for the Tolling Management System (TMS).

Main tasks and objectives of HTMS are to secure a safe, smooth and uninterrupted flow of traffic during normal operating conditions and to minimize traffic disruptions in the event of accidents or other incidents affecting the safety and use of the ORR through the provision of rapid and effective response mechanisms with proper liaison procedures with police department and other relevant agencies. On the other hand main tasks and objectives of the TMS are to charge, collect and retain tolls in accordance with tolling management procedures, and to manage ETC, ETC accounts and ETC equipment including maintenance.

Taking into consideration the character of HTMS and TMS, special attention should be given to legal and regulatory frameworks on the respective establishment of the new organization and its contracting with private concessionaires, and also the revenue management on tolling through an escrow account.

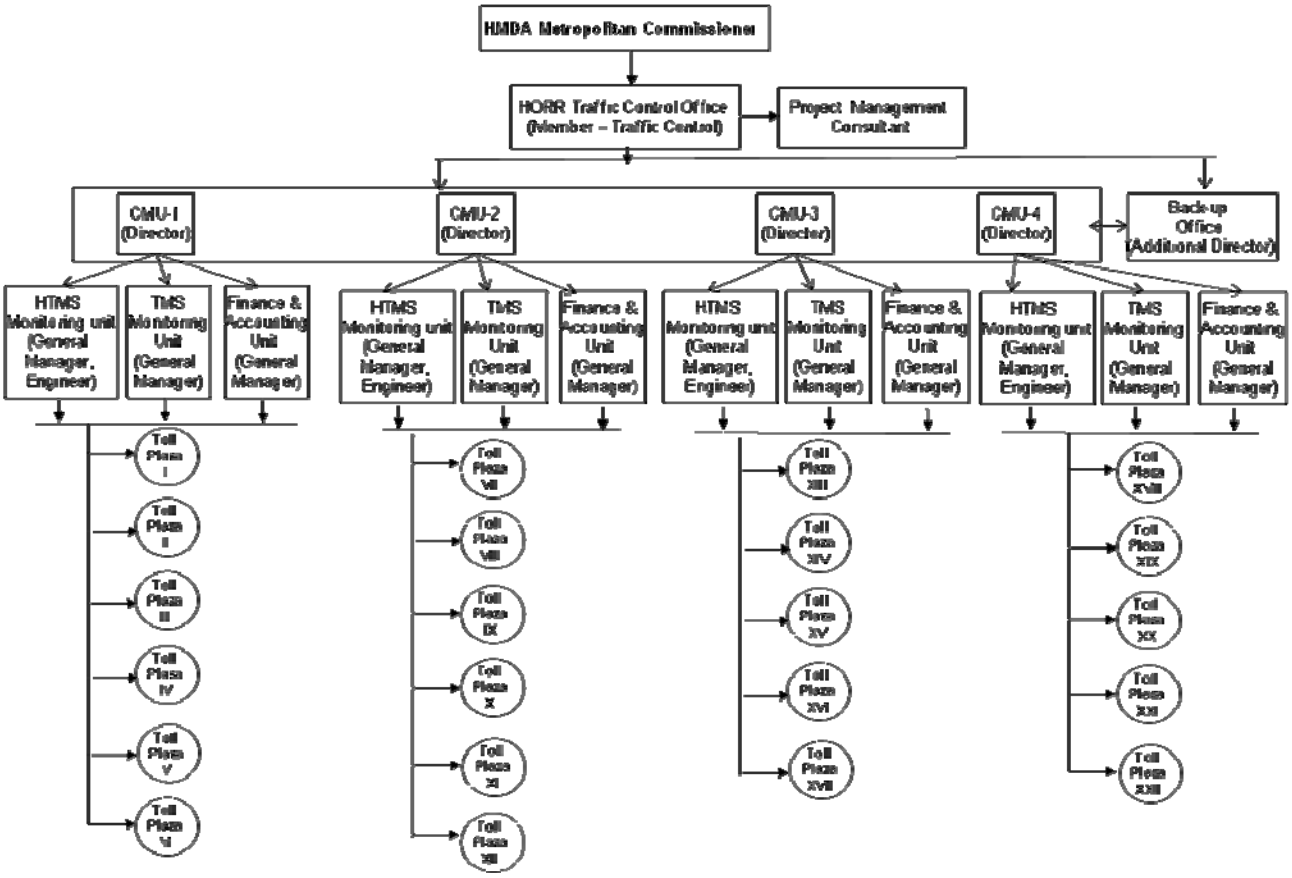
Organization Design

The new organization will be headed by the Member – Traffic Control in HMDA and supported by a minimum of four (4) directors of corridor management units (CMUs) and a director of the back-up office. Since the main traffic control office always has a back-up office, the directors of the CMUs shall have day-to-day contact with the additional director in charge of back-up office. The main traffic control office should be the base camp for all intervention services such as patrolling activities, ambulances, towing/crane services etc.

Director(s) in charge of CMUs are supported by three (3) monitoring sub-units, i.e., the HTMS Monitoring Unit, the TMS Monitoring Unit, and Finance & Account Monitoring Unit. Each such monitoring unit is headed by a general manager who closely supervises between five (5) to six (6) toll plazas through the HTMS, TMS, and Finance & Account.

The PMC who will be hired under the JICA-funded Phase IIB will make the necessary advices, including the preparation for ITS operation and management manuals.

Figure 5.1 Proposed ITS Organization



6 Conclusions and Recommendations

Conclusions

The SAPI Study has fulfilled its assigned tasks. Some significant conclusions are provided per task as shown below.

Task 1: Traffic demand on the ORR was analyzed. Results showed a low traffic demand on the ORR alignment at present. There are two main factors at play here: (1) a large share of 2- and 3-wheel vehicles in the current traffic, ranging from 20% to 58%, which will not be allowed on the main ORR carriageway once it becomes operational; and (2) the likely diversion of only a small share of traffic from the present radial roads to the ORR to enjoy shorter travel distances, e.g. around 15% at the maximum of the existing radial road traffic. Therefore, the promotion of roadside developments in an orderly manner such as new settlements and SEZs will be of utmost importance to make the ORR investment viable.

The original interchange design did not consider toll collection in a closed system and thus the SAPI Study modified it. Specifically, it modified major interchanges connecting with the national and state highways from a clover-leaf shape to a double-trumpet shape except for the Shamshabad Interchange. The modification produced some positive side effects such as reduced construction cost and smaller land requirement because of the compactness of the new interchange design.

Task 2: During the ITS development planning process, the SAPI Team worked along the line of two (2) development strategies: “integrated operation and management” and “basic and upper-system-compatible.” To meet the first strategy, the proposed advanced HTMS features additional facilities and equipment compared with the original one, such as a TCC, optical fiber cable connection, and CCTV use. It is also designed in a way that all tolling services would be managed at the TCC. To meet the second strategy, the global ETC system, consisting of microwave DSRC (5.8 Ghz) with active OBU, is recommended, after comparing technology alternatives in the aspects of performance, economy and expandability.

Task 3: For effective project implementation, a broad knowledge of various ITS equipment was required from both consultants and contractors. However, there are only a few suppliers who can provide all the ITS equipment that the project will need. Thus, ITS equipment procurement should be undertaken in two contracts: one for advanced HTMS equipment and another for tolling management services (TMS) equipment. At the same time, one contract will be needed for project management consultant (PMC) services. These three contracts will be done for 15 months at the end of the ORR construction. If the ORR can be fully operational by the end of 2011, the contracts must commence from October 2010.

Task 4: To operate and manage the proposed ORR ITS, a new organization will be necessary. Since the future role of the HGCL after the completion of the ORR road construction is uncertain, the SAPI Team agreed with the HGCL to establish a new organization within the HMDA. The head office of this new organization will be located at the TCC, controlling both the advanced HTMS and TMS in coordination with branch offices such as sub-TCCs and toll gate offices.

This new organization must be lean, efficient, transparent, and capable of utilizing modern technology and systems in its operation and management work. When contracting routine works out, the operation, management, and transfer (OMT) concession for a certain period is worth considering in the ORR ITS project.

In addition to the original TOR, an overseas training program was conducted. Between March 31 and April 7, the Japan ITS Tour involved five participants from HGCL, two from the Ministry of Shipping, Road Transport and Highways, and one from the National Highway Authority of India. The tour, consisted of field surveys and workshops, was informative in providing the participants with a better understanding of the SAPI Study.

Recommendations

(i) The ORR ITS organizational development should be done in two phases. The first phase operation will start between Phase I and Phase II-A sections at the mid of 2010 although no ETC equipment would be available at that time. A new organization will have to come in to be responsible for manual toll collection, as well as the provision of basic road information and rescue services when accidents occur.

(ii) A new organization must be completely operationalized before the ORR's full opening or by the end of 2011.

(iii) The TCC has a strategic role in the project. However, no such TCC has ever been established in India; therefore, local capacity for TCC operation should be developed with the help of external support.

(iv) The technology strategy for the ORR project:"basic and upper-system compatible," is quite crucial within the context of Hyderabad metropolitan development. It is broadly recognized that Hyderabad intends to strengthen IT investment and development. ITS development can push this move especially when ITS manufacturing and related services are encouraged as local industries. After the full operation of the ORR by 2012, it is recommended that continuous efforts be made to pave the way for a metropolitan-wide ITS development.

(v) For the blueprint of such an ITS-based metropolis, an ITS development plan at the metropolitan level is a prerequisite to show the way to a progressive and efficient evolution and expansion of the ITS services from the ORR to other metropolitan roads. At the national level, a standardization policy on ITS development is badly needed, particularly on ETC technology. In this sense, the Hyderabad ORR ITS project serves as a pioneering effort in the country.

(vi) Although the SAPI Study is completed, there are still some areas where the HGCL need to receive professional advice on before the PMC contract commences in October 2010.

- Preparation of a new organization for the ORR ITS operation and management;
- Preparation of initial manual toll management services, including establishing the legal framework and procedure for toll fee transactions and provision of related trainings;
- Further advice on bidding documents and selection of qualified ITS equipment suppliers and consultants; and
- Technical advice on the evaluation of proposals to be submitted by eligible ITS equipment suppliers and consultants.