Intelligent Transport System for KSRTC, Mysore – Detailed Project Report

2008

CENTRAL INSTITUTE OF ROAD TRANSPORT

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EXECUTIVE SUMMARY

Intelligent Transport System

Implementation of Intelligent Transport Systems is a pioneering effort by KSRTC to contribute to the first step in providing dynamic information of bus routes. On completion of this project, it is bound to encourage use of public transport by reducing the use of personal vehicles significantly, contribute to saving the environment from heavy vehicle pollution and ease congestion on city roads. This is achievable because ITS brings in benefits, which include improving the accessibility of the system, safety of users, traffic efficiency, environmental quality, energy efficiency and economic productivity. Also, it reduces waiting time, travel uncertainty, fuel consumption, emissions, operational costs and traffic congestion.

The Intelligent Transport System Project to be implemented at Mysore addresses the critical issue of road congestion by offering state-of-art technologies and attractive, convenient, comfortable, value added services to encourage the usage of bus services against individual personal vehicles. Mysore has been chosen since it is a potent place given its historical background, tourist activities, high growth rate in traffic density in the recent past, medium city size making the project affordable, trip profile and a projected 70% increase in the land use profile. Also, Mysore city, with all the modern infrastructural amenities, offers several opportunities to the people to earn their livelihood thus attracting several people from other states for employment thus increasing the population of the city manifold in the near future.

KSRTC currently operates about 4217 trips in Mysore through 282 schedules from 2 depots on 185 routes with a fleet strength of 258 resulting in 1.79 lakh passenger trips per day with a load factor of 72.8% and 555,475 effective kilometres per day. The modal split figures for Mysore city indicate that the share of trips performed by public transport is only 13%, which can still be increased, as the proportion of walk and two-wheeler trips is high.

Significant modal shift is needed to deliver national and international sustainable development aims for a strong economy, an inclusive society and a clean environment. A significant trend amongst many urban road users is a willingness to use the public transport in the face of increasing traffic congestion and increasing 'road-rage' behaviour on the roads. With the spiralling crude prices in the international market and the rising cost of fuel, many would shift to the public transport on cost considerations. For some, time is of the essence and a modal shift will occur only if the new mode offers time improvements, while for others it is mostly a matter of costs. KSRTC aims to bring about this modal shift in the city of Mysore by improving the perceived image of KSRTC services.

The current project aims to improve the reliability of KSRTC city services through effective Travel Demand Management measures, Emergency Management System and reduction in the waiting time of its passengers. Therefore given the critical

success factors of availability, reliability, accessibility, security, low costs and comfort (acceptance), the increase in the use of public transport is definite to occur. It is very interesting to note that from results of the stated preference survey conducted by the consultants, it has been found that almost 89% of the sample population is willing to shift to public transport provided KSRTC operates reliable services through the introduction of ITS. This further translates to 17.66% of the users of two-wheeler mode transport shifting to the use of buses.

An Intelligent Transport System must meet the essential criteria such as Availability, Accessibility, Assessment and Acceptance to assure KSRTC the acceptance of ITS system by different stakeholders to increase patronage towards the public transport system. The requirements of various stakeholders have been factored into the study driving the recommendations contained in this report.

The core objectives of deploying Intelligent Transport System in the city of Mysore include:

1. Providing effective, safe, environmental and commuter friendly solutions to the travelling public who use KSRTC buses.
2. Track and monitor the movement of buses on real time basis to enable communication of the arrival timings of buses at the bus stops through state of the art GPS/GPRS technologies
3. Inform commuters about the bus routes and arrival timings of buses at the bus stops/terminals through LED Display systems.
4. Effective management through a Decision Support system by collecting, collating and storing information on real time basis about the transport system and its effectiveness using communication technology.
5. Instant access to information related to bus schedules, ETA, ETD, annunciating bus stop names, fare details, etc at bus stops, bus terminals and within the buses and through SMS, Internet and IVRS.
6. Issuing of Passes Daily, Weekly, Monthly for commuters and e-purse facilities through Smart Cards.
7. Facilitate timely management of Incidents/Accidents
8. Establish meaningful instant two-way interaction facility between Driver and Central Control Station.
9. Obtaining on-line real time information on bus operations and management.
10. Effective monitoring of breakdowns and the related information.
11. Effective diversion of traffic in case of emergency.
12. Monitoring accidents and the related aspects.

The overall scope of the implementation will consist of design, development, testing, installation, commissioning, training, operations, and management of facilities for a period of three years by the winning bidder. This project is planned to cover 500 Buses, 80 Bus Stops and 2 Bus Terminals having the components of Vehicle Tracking System, Central Control Station, Passenger Information Management System, Communication Sub System, Travel Demand Management, Incident and Emergency Management System, Operational and Maintenance Specification and Fleet Management System.

ITS will cover core systems such as Vehicle Tracking System, Real Time Passenger Information System and Central Control Station. Core technologies include Geographical Positioning System (GPS), Electronic Display Systems, and Information & Communication Technologies. 42" LCD Display unit can be installed for displaying details of Arrival and Departure information of the buses in Kannada and English. Vehicle Mounted Unit(VMU) will update the location information like Latitude and Longitude to the central server through GPRS. The next arrival bus stop information and the current bus stop information will be displayed inside the bus for the passengers based on the location information collected by VMU. The next arrival bus stop information and other necessary information can also be announced inside the bus. Driver will be given a keypad interface for the voice communication. Expected time of arrival of the bus will be displayed at the bus stops. Communication Headset will be provided to the driver to interact with Central Control Center. The GPS (VMU unit), Display units and Central Control Station will be integrated with appropriate interfaces to work in sync with each other seamlessly. Daily Reports on Bus stops skipped, Speed violation, Driver duty performance, Daily out shedding deviation report, Driver wise improper stopping and Details of Missed trips can be generated through this system.

ITS Project proposed by KSRTC at Mysore does not include any activity which contribute to negative environmental impacts such as air pollution, water pollution, noise pollution, visual intrusion, community severance and vegetation / land degradation. On the other hand, it has several social benefits such as improvement in safety, reliability and punctuality, delay reduction, capacity improvements, commuter satisfaction, reduction in the use of private vehicles, travel uncertainty and traffic congestion.

The projected cost estimate for the deployment of ITS in KSRTC city services in Mysore is around Rs. 19.13 crores. A survey conducted revealed that 89% of the sample population is willing to shift to public transport of KSRTC IT buses. It is thus estimated that the total revenue increase due to the introduction of ITS in KSRTC services in Mysore is estimated at Rs. 6.87 crores per year. Hence, it is expected to recover the total project cost within a span of three years. Additional revenue sources such as Advertising on the Bus body, inside the buses, Online Advertising, Subscriptions and Google Ad-sense have also been identified. The reduction in fuel consumption due to the projected modal shift is to the tune of around 44000 litres of petrol per year. This will result in a net savings of Rs. 24.17 crores per year going by the current fuel prices. The life span of the project is expected to be around six years, which constitutes the three-year implementation period and an additional period of three years considering the life expectancy of the components installed.

It is necessary that KSRTC set up an apex level Project Management Committee (PMC) to ensure the overall progress of the project. Vice-Chairman & Managing Director, KSRTC should nominate the Chairman of the Committee. This committee needs to have Finance, Stores, Engineering, Civil & Electrical and IT department representatives to ensure that decisions are taken in consultation with the key departments, which would in turn be influenced by the new system in the work processes.

To ensure professional management of the project it is recommended that the Project implementation be outsourced to a professional agency identified by KSRTC in order to manage integration, scope, time, cost, quality, human resources, communications, risk and procurement covering the key project phases of initiating, planning, executing, controlling, and closing applying a 6-Q framework. This is highly essential to ensure that the tasks are carried out for a definite purpose using the best of techniques and methodologies covering all the stakeholders' interest in a timely manner and at appropriate places. It is further recommended that the project progress be monitored based on fortnightly reports covering accountability, skills, collaboration, reporting, alerting, quality control and escalation procedures.

In addition to the Project Management Agency (PMA) being set up, the Project Implementation Vendor also needs to set up their own project monitoring mechanisms and report to the Project Monitoring Agency for which the PMA should provide the necessary templates.

KSRTC will float tenders for global participation on a two-bid system that consists of Technical bid and Commercial bid. The bid process including the Functional, Technical, general instructions & commercial details and the legal contracts have been detailed in the Request for Proposal (RFP). The tender procurement norms furnished in the RFP are to be adopted for the selection of vendor for implementation, Operations & Maintenance of the project.

An overview of the roles and responsibilities of the key stakeholders (KSRTC, Project Implementation Vendor and the Program Management Agency) have also been outlined in the Detailed Project Report to ensure a smooth execution of the project.

A Project Plan has been chalked out with specific details on schedule, milestones and work breakup for the project implementation within the given time framework. The contractor who implements the project will also be responsible for the maintenance & operations during the post implementation period.

ITS must be effectively maintained and managed to ensure that all services are delivered without any break. It is in this end that the basic procedures for the Maintenance & Support and administration of computing resources of ITS Project have been furnished. This is expected to develop a perfect synergy between the user and the machine to define, identify, analyze, maintain, and communicate on-line data between the end users and the decision makers.

This document is a Detailed Project Report that will facilitate KSRTC Management to take the next steps in finalizing the Request for Proposal specifications covering the functional, technical, operational specifications including detailed definition of various service level metrics. This Detailed Project Report also covers the estimated cost of implementing the system with scope for expansion as the number of buses, routes and commuters increases.

Innovative Environment Project

Promoting clean environment with the usage of low emission buses for Public transport and reducing the use of fossil fuels to achieve energy savings have gained utmost importance in the recent years. The introduction of Karnataka SRTC buses operating on Diesel blended with ethanol fuel and fitted diesel particulate filter for Mysore (Innovative environmental project for Mysore City) would certainly be a vital step towards this endeavour.

Green House Gas (GHG) emissions across the globe are increasing most rapidly in the transportation sector. A major issue of global concern at present is the increasing contribution of the transport sector to carbon dioxide (CO_2)—the main greenhouse gas (GHG) produced from the use of fossil fuels—and its consequences on global warming and climate change. The use of Diesel blended with ethanol fuel would not only reduce GHG (CO_2) emissions but would also significantly reduce levels of other harmful pollutants emitted by Diesel Buses.

The technical troubles observed during the initial years with regard to ethanol-diesel blends can now be overcome by using a solubiliser for blends and flame arrestors in diesel tanks of buses. The blending of Ethanol and Diesel by an electronic on-site blending equipment and innovative additive technology is now possible. This creates a stable clear solution of ethanol and diesel ready for use in diesel engines. The necessary infrastructure changes such as installation of Ethanol storage tanks & Computerized Blending Equipments at Depots at Mysore and fitment of Flame Arrestors for Diesel Tanks, fitment of diesel particulate filters in the bus are to be carried out.

For reasons of fuel efficiency, emissions performance, and economics, a 7.7 vol% fuel ethanol blend can be utilized for maximum benefits. The advantages of usage of Ethanol diesel blends with solubiliser also include Enhanced lubricity, Added Cetane, Improved corrosion resistance, Excellent response and power, Increased life of engine and other components and Increased life of engine oil. The development of bio fuels (Ethanol) is also likely to have significant social impacts, including job creation (quality and permanence), social responsibility and social equity, including issues such as wealth distribution to rural communities. The rural poor in India who are mainly farmers involved with agricultural production are likely to gain from the development of Ethanol fuel.

The Economic gains associated with the introduction of Ethanol-Diesel blends for buses would also be significant. The total savings across fleet of Mysore / annum would be to the tune Rs 1.15 crores, thus with 9 % increase in consumption levels, net savings would amount to Rs. 3.80 crores over a project span of 3 years. This compares favorably with the total project cost of Rs. 3.57 lakhs.

Project Cost Summary

KSRTC plans to source funds from the MoUD, GoI under the GEF SUTP to implement ITS and E-Diesel projects, in consistent with the GEF SUTP objectives. The total cost of the project for the introduction of real time passenger information system, fitment of diesel particulate filters and the use of e-diesel (Ethanol-diesel blend) for Karnataka SRTC buses plying in Mysore is around Rs. 22.70 crores. Of the total project cost, Rs. 8 crores (35%) is to be borne by GEF Funding and Rs. 11.7 crores (52%) is to be bear by the Government of India. The State Government of Karnataka and Karnataka State Road Transport Corporation are to bear the balance amount of Rs. 2.94 crores (13%) to the tune of Rs. 1.47crores each.

The fund flow statement prepared accordingly stipulates that around 73% of the total project cost is to be released during the first year, 9% in the second year and 18% in third year. The summarised project cost for ITS and Innovative Environment Project for KSRTC, Mysore is tabulated below :

Project Cost

Sl. No.	Agency	Project Contribution Source	Amount (Rs. Lakhs)
1	GEF & GOI	GEF + GOI Funding	1975.99*
2	Government of Karnataka	Grant towards its share	147.01@
3	KSRTC	Grant towards its share	147.01©
		Total	**2270.00**

** GOI Contribution is Rs. 11.76 crores (i.e., 80% of Rs. 14.7crores) and GEF Contribution is Rs. 8 crores*

@ State Government = Rs. 1.47 crores (i.e., 10% of Rs. 14.7 crores)

© KSRTC = Rs. 1.47 crores (i.e., 10% of Rs. 14.7 crores)

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A. Overview of the project

Karnataka State Road Transport Corporation (KSRTC), the implementing agency, was established in August 1961 under the provisions of the Road Transport Corporation Act 1950 with the objective of providing "adequate, efficient, economic and properly coordinated road transport services". Three Corporations viz., BMTC, Bangalore from 15-08-1997, NWKRTC, Hubli from 01-11-1997 and NEKRTC, Gulbarga from 01-10-2000 were formed out, on a regional basis, with KSRTC doing operations covering Southern Karnataka and interstate areas.

KSRTC operates its services to all villages in the State, which have motorable roads. 92% of the villages in monopoly area (6743 out of 7298) and 44% in non-monopoly area (5158 out of 11789) have been provided with transport facility by KSRTC. At present it has one corporate office, 11 divisional offices, 57 depots, 110 bus stations, 2 bus bodybuilding workshops,1 printing press, 3 training Institutes and 1 hospital. It operates 5100 schedules with 5400 vehicles (including 164 hired private vehicles) covering 19.50 lakh Kms. and carries on an average 22 lakh passengers daily. About 25000 employees are working in the Corporation.

Implementation of Intelligent Transport Systems is a pioneering effort by KSRTC to contribute to the first step to provide dynamic information of the bus routes, ETA/ETD, improve efficiency in transport management, and lower the pollution levels.

On completion of this project, it will encourage use of public transport and reduce the use of personal vehicles. This significantly contributes to saving the environment from heavy vehicle pollution and reducing congestion on city roads.

The ITS Project is proposed to be implemented at Mysore; the city located in the southern part of Deccan Plateau is a potent place, given its historical background and a salubrious climate for tourism. KSRTC services in Mysore cater to the population of the city which is over 2.2 million.

The total area of Mysore city as per MUDA is expected to increase from 9221 hectares (2001) to 15,669 hectares by 2011, representing a significant increase of around 70%. It is observed that the number of vehicles increased almost 25 times to 145,000 in 1996 from around 6,000 in 1970.

The network of roads and streets in Mysore follows a hub and spoke mechanism with arterial roads originating from the centre of the city. Arterial roads start from the Palace area and run radially leading to towns and cities outside. This arrangement also means that all commercial activities converge to the centre of the city causing congestion.

It is estimated that about 5.7 lakh passenger trips are generated each day within the urban limits, with home-based trips (to & fro) constituting nearly 50%, followed by home-to-work which is 23.2% and home to educational institutions factoring 19.5%.

The number of sub-systems covers vehicle-to-vehicle communications, collision avoidance and crash detection system, monitoring traffic and controlling signal lights, electronic and speed limit signs, reversible lanes and other road safety components. ITS technology framework includes wireless communication, sensing technologies, inductive loop detection, video vehicle detection and electronic toll collection.

KSRTC plans to source funds from the MoUD, GoI under the GEF SUTP to implement ITS project, in consistent with the GFE SUTP objectives. As a first step, preparation of a Detailed Project Report (DPR) on ITS for KSRTC Mysore limits its scope primarily to Passenger Information System and including certain core components has been assigned to CIRT, Pune, who will act as consultant to the project.

The proposed ITS project implementation will include core components such as : Vehicle Tracking System, Real Time Passenger Information System and Central Control Station. Core technologies include Geographical Positioning System (GPS), Electronic Display Systems, and Information & Communication Technologies.

Benefits of introducing ITS include:

- Reduce waiting time and uncertainty
- Increase the accessibility of the system
- Increase the safety of users
- Reduce the fuel consumption and emissions
- Reduce the operational costs
- Improve traffic efficiency
- Reduce traffic congestion
- Improve environmental quality and energy efficiency
- Improve economic productivity

A Detailed Project Report will facilitate KSRTC Management to take the next steps of developing the Request for Proposal specifications covering the functional, technical, operational specifications including detailed definition of various service level metrics. This DPR also covers the estimated cost of implementing the system with scope for expansion as the number of buses, routes and commuters increases.

The KSRTC plans to source funds from the MoUD, GoI under the GEF SUTP to implement ITS project, in consistent with the GFE SUTP objectives.

KSRTC proposes to implement the system through established bid process for identification and deployment through a system integrator.

As a first step, preparation of a Detailed Project Report (DPR) on ITS for KSRTC Mysore limits its scope primarily to Passenger Information system and including certain core components has been assigned to CIRT, Pune, who will act as consultant to the project.

A-1. Why Mysore City for the ITS project

ITS Solutions worldwide has been prominent in the development of efficient, transparent and environmental friendly public Transport solutions resulting in growth of economies and transport.

Sustainable transport is not just a case of increasing the infrastructure available; it is also a question of maximizing the use of existing infrastructure and of maximizing the efficiency and interoperability of all transport assets.

Implementing an ITS solutions gets more and more complex based on the size of the transport network to be addressed and the size of the city and intricacies of traffic conditions.

The cost of implementing an ITS solution is related to the size of the city and the Various other parameters that is addressed in the solution. Hence a smaller city with a smaller fleet of public transport is ideal for a pilot project.

In India we are just beginning to understand the need for an ITS solution and we do not have a working model which can be used for case study.

KSRTC initiative will be one of the first in the country. Hence this project has been undertaken as a pilot project to become a model / case study for other projects.

Changing the traditional ground transportation scheme to a fully automated and intelligent transportation network is a substantial upgrade of the scheme. Apparently the main problems that are hampering this upgrading to materialize are not just technological limits, but cultural, conceptual, social, emotional, political and economical hurdles. The bigger the city the more complex this becomes.

The inhibitions and barriers that are hampering innovative ground transportation systems are complex, diversified and interlaced one into another. Many different interests are entangled in the transportation world, and one factor may ruin a whole scheme or vision. Transportation scheme can be compared to huge clockwork, in which the component are co-dependent and integrated. Interference in this scheme should be done delicately, incrementally, intelligently, and morally.

In an unperfected trial to epitomize the problems it may be said that upgrading ground transportation system is a process of mediation between the anticipation of the past and the fears and prospects of the future. Hence it is in the best interest of all stakeholders to:

- Be a modest step to impel the complicated evolutionary process of transportation metamorphosis.
- Concretize an abstract vision to a basic platform plan.
- Provoke awareness, negotiations or debates.

- Implement a project that is world class in its concept, design, implementation and management of automatic intelligent ground transportation system.
- Bring in superior standards in passenger information, and transparent reporting and MIS systems

Considering various factors highlighted above, Mysore city offers us the best option for the following reasons:

- Mysore is a tourist centre and needs to be a model city to provide international standard facilities for local public transport. This will improve the inflow of tourist and also give a good image of our state.
- The city is a medium sized city thereby making the investments to be made for pilot project affordable. The city is experiencing a high rate of growth in traffic density.
- The city located in the southern part of Deccan Plateau is potent place, given its historical background and a salubrious climate. KSRTC services in Mysore cater to the population of the city which is over 2.2 million.
- It is estimated that about 5.7 Lakhs passenger trips are generated each day within the urban limits, with home-based trips (to & fro) constituting nearly 50% , followed by Home-to-work which is 23.2% and home to educational institutions factoring in 19.5%.
- It is observed that the number of vehicles increased almost 25 times to 145,000 in 1996 from around 6,000 in 1970.
- The total area for Mysore city as per MUDA is expected to increase from 9221 hectares (2001) to 15,669 hectares by 2011, representing a significant increase of around 70 %.
- It is easier to evaluate a project of smaller size city due to lesser complexities in the project parameters.
- Other cities like Bangalore are very large in size with a lot of limitations and will require networking with many agencies which will render the project unviable for the time being. The cost of implementing ITS project in Bangalore will be substantially higher. It is assumed to be wiser to implement a project at Mysore and learn lessons coming out of the project successfully implemented.
- There is a lot of other concurrent projects being undertaken /proposed for Mysore city in terms of road up-gradation, new road networks, ring roads etc which will necessitate new Public Transport Support thereby increasing the Transport network and schedules.
- The funds available for the project will match the project cost for implementation in a city of the size and infrastructure availability such as Mysore.

B. Issues

B-1. A backdrop of Mysore

B-1-a. General / Historical background

Cultural capital of Karnataka, Mysore is a majestic, mysterious and mesmerising city. It has inherited all Indian traditions with modernity. Mysore has a number of historical and heritage buildings.

The earliest mention of Mysore can be traced back to the days of King Ashok, back in time around 245 B.C. However, it is only from the 10th Century that a proper and consistent line of history of Mysore can be traced. History of Mysore points out that it was in 1399 A.D that the Yadu dynasty came to power in Mysore. From the year 1761 to 1799 Mysore was ruled by Hyder Ali and his son Tippu Sultan. Mysore remained the second most important city till the death of Tippu Sultan. As Mysore went under the control of the Britishers, they placed a Prince Krishnaraja Wodeyar on the throne of Mysore and Mysore was once again made the capital in the year 1881. The city started to grow from time to time. Chamarajendra Wodeyar was the next king who ruled for 13 long years.

The civic administration of the city is managed by the Mysore City Corporation, which was established as a municipality in 1888 and later converted into a corporation in 1977. The corporation oversees the engineering works, health, sanitation, water supply, administration and taxation in the city. It is headed by a mayor who is assisted by commissioners and council members. The city is divided into 65 wards and the council members (Corporations) are elected by the citizens of Mysore every five years. The council members in turn elect the mayor.

The growth and expansion of the city is managed by the Mysore Urban Development Authority (MUDA), which is headed by a commissioner. Its activities include developing new layouts and roads, town planning and land acquisition. One of the major projects recently undertaken by MUDA is the creation of an Outer Ring Road in Mysore, which is expected to ease traffic congestion.

B-1-b. Location, Climate, physical setting, regional linkages

Mysore city is geographically located between 12° 18'' 26 North Latitude and 76° 38' 59'' East Longitude. It is located at an altitude of 2,427 feet. It encompasses an area of 6,268 sq. km. It enjoys a pleasant climate, the temperature varying between 19° C and 30° C. The weather of Mysore is pleasant throughout the year. As Mysore city is located in the tropics, it enjoys a moderate climate.

Mysore city is located in the southern part of the Deccan Plateau. It is a beautiful land bordered by luxuriant forests. It is located 140 Kms from the city of gardens, Bangalore. Mysore is an important railway junction for the district. It is connected to Bangalore, which lies to its northeast via Mandya, the rail junction at Hassan is situated to the northwest, and Chamarajanagar via Nanjangud to the southeast. Infrastructure of Mysore comprises of a wide gamut of civic amenities such as sanitation, solid waste management, water supply as well as transport network. The governing authorities of Mysore are taking major initiatives to further develop the state of infrastructural facilities in the city.

Bangalore is the nearest airport of Mysore. Mandakalli is the proposed place where the airport with two runways is to be built in Mysore. As per the government declaration, the airport of Mysore will start functioning by the year 2009. The road infrastructure of Mysore is quite developed and links the place with Bangalore. Since Bangalore is one of the popular and easily reachable cities of India one can conveniently reach Mysore. The frequency of buses that ply from Bangalore to Mysore is quite good and tourists can also enjoy the scenic pleasures of the surroundings while taking a bus ride.

The railway infrastructure of Mysore provides regular train services from Bangalore to the place and vice versa. The closest airport to Mysore is in Bangalore which is at a distance of around 140 km. In recent times Mysore has been transformed into a pioneer of wireless communication technology through the Wi-Fi system. Today, not only tourists but also IT professionals visit Mysore in large numbers. The advent of Wi-Fi in Mysore has literally transformed the city into one of the advanced IT zones of the world. As a result of the Wi-Fi revolution in Mysore, the city gained a complete infrastructure of wireless communication system. A company called WiFi Net installed three towers in Mysore city with a total investment of 60 Lakhs. This in turn led to the activation of the wireless process in Mysore. Ever since the Wi-Fi technology came into Mysore various corporate organizations and individuals are opting for its facilities. There is no denying the fact that Wi-Fi in Mysore has provided a major boost to the complete IT industry of Karnataka as a whole.

B-1-c. Demographic and socio economic profile:

The total population of Mysore is about 2.28 million. There are people from various cultural backgrounds gathering in the city due to the recent development of flourishing IT industry. Thus the population of Mysore is a combination of traditional locals and modern tech savvy youth gathering here for work from different corners of India. Most commonly, the people of Mysore speak both Kannada and English. Tamil and Hindi are the other two popular languages in Mysore.

The Population of Mysore city comprises of 7.8 lakh urbanites. One of the prominent cities of Karnataka, Mysore is a burgeoning industrial center and tourism hub of South India. Mysore has a total male population of 399,904 and female population of 385,896 as per the census data of 2001. The gender ratio of Mysore is 965 females per 1000 males. The urban population of Mysore comprises of mostly literates who are engaged in important government and private commercial establishments and administrative offices.

The population density of Mysore is 6223.55 persons per square kilometre. The literacy rate of the city is 82.8%, which is much higher than the state's average of 67%. Nineteen percent of the population in Mysore live below the poverty line and 8.95% of the population live in slums. Though 35.7% of the population living in urban areas of Karnataka are workers, only 33.3% of the population in Mysore city belong to the working class. People belonging to Scheduled Castes and Scheduled tribes contribute to 15.1% of the population.

Mysore city is with all the modern infrastructural amenities, and it offers several opportunities to the people to earn their livelihood. The city of Mysore is sub divided into Mysore South and Mysore North for the convenience of administration. Being an important industrial centre of the state of Karnataka, Mysore attracts several people from other states for employment thus increasing the population of the city.

B-1-d. Growth, economy, spatial structure and trends

Traditionally, Mysore has been home to industries such as weaving, sandalwood carving, bronze work and production of lime and salt. The planned industrial growth of the city was first envisaged in the Mysore economic conference, held in 1911. This led to the establishment of industries such as the Mysore Sandalwood Oil Factory in 1917 and the Sri Krishnarajendra Mills in 1920.

In a survey conducted by Business Today in 2001, the business arm of India Today, Mysore was ranked as the 5th best city in India for business. Mysore has emerged as the hub of tourism industry in Karnataka, attracting about 2.5 million tourists in 2006. For the industrial development of the city, the Karnataka Industrial Areas Development Board (KIADB) has established four industrial areas in and around Mysore, located in Belagola, Belawadi, Hebbal (Electronic City) and Hootagalli areas. The major industries in Mysore include BEML, J. K. Tyres, Wipro, Falcon Tyres, L & T and Infosys.

Since 2003, information technology companies have been creating bases in Mysore, with the city contributing Rs. 760 crores (US$190 million) to Karnataka's Rs. 48,700 crores ($12.175 billion) IT exports in the financial year 2006–2007. Infosys has established one of the largest technical training centres in the world and Wipro has established its Global Service Management Center (GSMC) at Mysore. Non-IT related services have been outsourced from other countries to companies in Mysore.

B-2. Summary of CIRT Findings

B-2-a. Operational Characteristics of KSRTC in Mysore City

As on 31st March 2008, KSRTC operated 237 schedules under the city services with a fleet strength of 258. The city services were running with a load factor of 72.8% and 555,475 effective kilometres per day.

B-2-b. Bus Network Density

KSRTC operates about 4217 trips through 282 schedules from 2 depots on 185 routes making around 1.79 lakh passenger trips per day. The total number of bus stops in the city is about 484. The average revenue per passenger is about Rs. 8.20 through a fare of 34.76 paise per kilometre and an average distance of 8.38 kilometres per passenger. The average waiting at the bus stops is found to be around 15 minutes.

B-2-c. Activities involved and role of agencies in Bus Transport in Mysore

The main activities involved in transport management and the role of various agencies is presented in the table below:

Roles	MCC	MUDA	PWD	KSRTC	Mysore Police	CHESCOM, KUWSDS
Transport Planning	✓					
Road Construction	✓	✓	✓			
Road Maintenance	✓	✓	✓			
Traffic Enforcement					✓	
Traffic Devices – Signs, Signals, etc.	✓				✓	
Parking	✓					
Road Safety	✓				✓	
Bus Operations, including route planning				✓		
Utilities						✓

B-2-d. Ward-wise Population Details

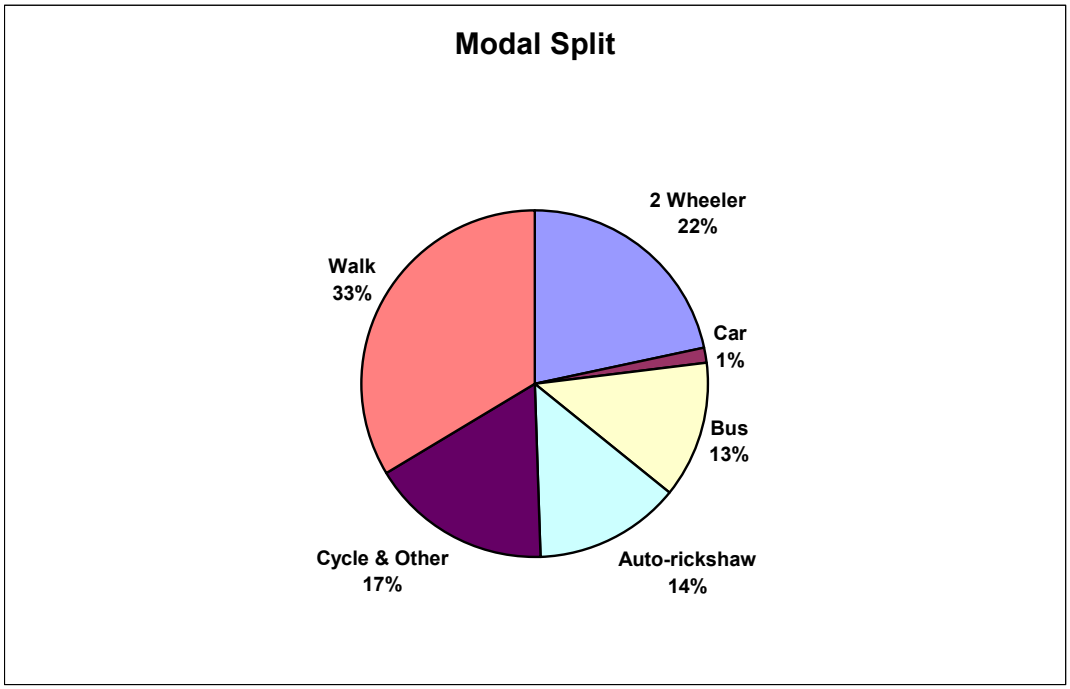
The entire city of Mysore has been sub-divided into 65 Municipal Wards for the purpose of municipal functions. According to the 2001 Census, a population of 757,379 resides in the 65 wards of Mysore city under the Municipal Corporation limits. The DPR for BRTS in Mysore City prepared by RITES in 2008 identifies four important corridors for public transport services. Two corridors cut across the city in the North-South direction and two in the East-West direction. These four corridors pass through 38 wards of the 65 wards in

the city catering to around 57.56% of the total population. A list of the wards that the individual corridors cater to is given below.

Corridor		Ward Numbers
C1	:	56, 57, 58, 63, 62, 64, 65, 1, 2, 36, 19, 20, 23, 24
C2	:	12, 11, 5, 4, 1, 36, 37, 41, 42, 44, 45, 35
C3	:	22, 24, 23, 20, 19, 36, 2, 1, 64, 37, 41, 51, 61, 52, 54, 53
C4	:	45, 46, 44, 42, 41, 37, 1, 2, 3, 6, 7, 9, 10, 11, 12, 13, 14

B-2-e. Modal Split

The distribution of passenger trips by mode is presented in the following figure. It may be observed that 22% of trips are performed by two-wheelers followed by 33% by walk. IPT and Cycles too have considerable share as nearly 14% and 17% of the trips are performed by these modes respectively. The share of trips performed by public transport is 13%, which can still be increased, as the portion of walk and two-wheeler trips is high.



B-2-f. Average Trip Length

Trip pattern of the urban area residents reveals a considerable proportion 33% of the overall trips made within study area to be walk trips. Average trip length works out to

be 3.36 km. per capita trip rate. The average trip length of individual modes of transport is given in the following table.

Mode	Average Trip Length(km)
2 Wheeler	3.7
Car	6
Bus	4.5
Cycle & Other	1.9
Walk	0.7

B-2-g. Modal Shift

Significant modal shift is needed to deliver national and international sustainable development aims for a strong economy, an inclusive society and a clean environment.

A modal shift occurs when one mode has a comparative advantage in a similar market over the other. Comparative advantages can take various forms, such as costs, capacity, time, flexibility and reliability.

A significant trend amongst many urban road users is a willingness to use the public transport in the face of increasing traffic congestion and increasing 'road-rage' behaviour on the roads. With the spiralling crude prices in the international market and the rising cost of fuel, many would shift to the public transport on cost considerations. For some, time is of the essence and a modal shift will occur only if the new mode offers time improvements, while for others it is mostly a matter of costs.

KSRTC aims to bring about this modal shift in the city of Mysore by improving the perceived image of KSRTC services. The current project aims to improve the reliability of KSRTC city services through effective Travel Demand Management measures and Emergency Management System and reduction in the waiting time of its passengers.

Therefore given the critical success factors of availability, reliability, accessibility, security, low costs and comfort (acceptance), the increase in the use of public transport is definite to occur. ITS with its state-of-art technology and convergence of different technologies such as the network, GPS, display systems and Information systems will contribute to meeting the critical success factors in the Intelligent Transport system.

B-2-h. Stated Preference Survey

The consultants conducted a survey on the 04th July 2008 to assess the impact and predict the modal shift to public transport system after the introduction of Real Time Passenger Information Systems through Intelligent Transportation Systems. The survey format is given in the figure below.

CENTRAL INSTITUTE OF ROAD TRANSPORT

Pune 411 026

1. Mode of transport currently being used:

Please tick wherever applicable

Walk	Cycle	2 Wheeler	3 Wheeler	Car / Jeep

2. Would you be shifting to Public Transport if reliable services are provided through Intelligent Transportation System (ITS)

Yes		No	

3. Would you like to have Arrival / Departure information displayed

Yes		No	

4. Number of trips made in a day: _____

5. Average distance traveled in a day: _____

6. Expenditure on petrol / diesel: Rs. _____ per day / week / month

Date of survey: Signature:

It is very interesting to note that from the stated preference survey conducted by the consultants, it has been found that almost 89% of the sample population is willing to shift to public transport provided KSRTC operates reliable services through the introduction of ITS.

Mode of Transport	Sample size	Willingness to shift	% Share
Cars	160	150	93.75
3 Wheeler	110	110	100.00
2 Wheeler	1290	1160	89.92
Cycle	300	240	80.00
Total	**1860**	**1660**	**-**
% of Total Sample	1000	89.25	-

Though this is the perceived opinion of the general public, the proportion of people actually shifting to public transport could be much lesser in reality. On having focus group discussion with the experts in the public transport domain it was concluded that the modal shift would be to the tune of 30% for cars, 50% for 3 wheelers, 10% for cycles and 70% for 2 wheelers.

This actually translates to 24.4% of the users of other modes of transport shifting to the use of buses. At a conservative year on year growth of 10%, this could reach 35% in the next five years.

B-3. Stakeholder analysis

An Intelligent Transport System must meet the different needs of stakeholders to increase their patronage towards the public transport system. The system must meet the essential criteria such as: (a) Availability; (b) Accessibility; (c) Assessment; and (d) Acceptance to assure KSRTC the acceptance of ITS system by different stakeholders.

The key stakeholders are the travelling public, the operative staff of KSRTC involved in efficiently running the buses as per schedule with well maintained buses and meeting the quality of international standards, the management of KSRTC and various eco-system partners such as suppliers of various resources and components required for efficient running of the KSRTC services, insurance companies, environmentalists and other transport users in the city as two-wheeler / four wheeler users etc.

Amongst the citizens, special provisions must be made for the physically challenged, senior persons, women and children who may have difficulties in accessing the services of KSRTC easily.

The range of interventions to meet the stakeholders' expectations could cover:

- Redesigning bus stops on-line display of bus arrivals
- Creation of suitable infrastructure at bus stops and bus stations for on-line real-time passenger information system.
- Fitment of onward electronic devices in the bus to support GPS and GPRS/GSM systems.
- Special seat allocation for old-aged, physically challenged, women and children and prioritizing their entry into and Exit from the buses before others.
- Instant access to real time update of the status of the bus schedules.
- Electronic ticket sale machine and fare collection system.
- Analytical data (both video and text based) for the top management to support effective management of the services of KSRTC.
- Real time communication with the drivers for incident / emergency management.
- Schedule and bus stop announcements through visual displays and voice based.

B-3-a. Travelers at the bus stops / stations

- Information availability on Bus routes (Bus Numbers: Starting – Destination Point – enroute stops), Schedule of the buses – ETA / ETD, Seat availability, approximate travel time in at least two languages – English and Kannada , point to point bus fares, types of buses – AC / Non-AC / Non-stop routes etc; accessibility to such information should be both visual and audio enabled.
- Redesigning bus stops for easy boarding at the bus stops (such as elevated bus stops, where the floor of the bus stand is at the same level as the entrance to the bus).

B-3-b. In-vehicle services for Passengers

- In-vehicle announcements through visual displays and audio system regarding next bus stop arrival and other related information.
- Special seat allocation for old-aged, physically challenged, women and children and prioritizing their entry into and exit from the buses before others.

B-3-c. Vehicle Drivers

- Two-way communication system between the driver and central control station for emergency /incident management.
- Passenger announcement system inside the bus.

Vehicle Information System to keep the drivers informed of the quality of various components and timely servicing / repairs of the vehicle components.

B-3-d. Operational Managers

- Facilitate operation managers to manage the entire fleet operations more efficiently through on-line remote access to vehicle positions, speed, breakdown, accident/ incident, etc
- Preparation of standard reports and charts to support all level of management in decision making.
- Two-way communication facility for instant contact with drivers in case of emergency incident /accident management/ diversions / traffic jams and warning of any traffic violations in real-time.
- Instant access to information such as: missed trips, late trips on different routes, break downs and its duration, vehicles offline, accidents – types, impact, losses etc, route-wise stop times for different trips at bus stops, average speed point to point, travel time analysis, improper stops at bus stops, driver behavior, deviation in routes, speed violations, at different locations and at different points of time

B-3-e. KSTRC Management

- Analytical data (video, text and numerical data) for the top management to support effective management of the services of KSRTC
- Cater to requirements of dynamic and context based specific reports graphs and charts and other standard Management Information System reports to give a snapshot view to the KSRTC management on daily, monthly, quarterly, half-yearly and yearly performance.

B-3-f. Eco-system partners

- Recorded / immediate access to information on various incidents and accidents to process insurance claims on buses / passengers; keeping track of the extent of pollution caused by KSRTC buses and initiate action on progressively bringing in less polluting fuel into the system; encouragement of two wheelers and car users to start using the public transport system to bring down traffic congestion and to keep the environment green and healthy

B-4. Vision of KSRTC

B-4-a. Core Objectives of ITS

KSRTC proposes to improve its capability in managing the entire public transport system in Mysore more efficiently, safely and be more Commuter and environmental friendly. This can be achieved by introducing real time communication interlinked with buses, passengers (in-vehicle, bus stations and bus-stands) and KSRTC Management by implementing intelligent transport system.

The core objectives of deploying Intelligent Transport System in the city of Mysore include:

1. Providing effective, safe, environmental and commuter friendly solutions to the travelling public who use KSRTC buses.
2. Track and monitor the movement of buses on real time basis to enable communication of the arrival timings of buses at the bus stops through state of the art GPS/GPRS technologies.
3. Inform commuters about the bus routes and arrival timings of buses at the bus stops/terminals through LED Display systems.
4. Effective management through a Decision Support system by collecting, collating and storing information on real time basis about the transport system and its effectiveness using communication technology.
5. Instant access to information related to bus schedules, ETA, ETD, annunciating bust stop names, fare details, etc at bus stops, bus terminals and within the buses and through SMS, Internet and IVRS.

6. Issuing of Passes Daily, Weekly, Monthly for commuters and e-purse facilities through Smart Cards.
7. Facilitate timely management of Incidents/Accidents
8. Establish meaningful instant two-way interaction facility between Driver – and central control station.
9. Obtaining on-line real time information on bus operations and management.
10. Effective monitoring of break downs and the related information.
11. Effective diversion of traffic in case of emergency.
12. Monitoring accidents and the related aspects.

B-5. Existing urban transportation scenario and facilities available in the use of urban transport – issues & challenges

EXISTING SCENARIO

The road pattern in Mysore is a combination of radial and grid pattern with arterial roads originating from the city centre. The Palace is the focal point from where the roads run radially leading to outer areas of the city. State Highways 17, 33, 86 & 88 pass through the city.

- SH-17 connects Mysore to Bangalore
- SH-33 to Manantavady
- SH-86 to Bangalore via Kanakapura
- SH-88 to Bantwal.

In addition to these, the city has a number of arterial roads (within the jurisdiction of Mysore City Corporation (MCC), Mysore Urban Development Authority (MUDA) and Public Works Department (PWD)).

The main radial roads, which originate from the Palace are Hunsur Road, KRS Road, Bangalore Road, Mahadevapura Road, Bannur Road, Ooty Road, H.D. Kote Road and Bogadi Road. The other major roads in Mysore include:

M.G. Road	Dhanvantari Road	Mirza Road
Vani Vilas Road	Ramanuja Road	Radhakrishna Avenue
Jhansi Rani Lakshmi Bai Road (JLB)	Sayyaji Rao Road	Seshadri Iyer Road
Chamaraja Double Road	Ashoka Road	Ramavilas Road
Devaraja Urs Road	New Sayyaji Rao Road	Adichunchanagiri Road
Kantharaja Urs Road	Irwin Road	Sawday Road
Lokaranjan Mahal Road	Karanki Tank Bund Road	Lalith Mahal Road
Maharana Pratap Simhaji Road	Dr. B.R. Ambedkar Road	Chamundi Hill Road
T. Narasipura Road	Race Course Road	Madhavachari Road
Vinoba Road	A.V. Road	

In addition to the above roads, Outer Ring Road (ORR) on the periphery of the city has been constructed by MUDA. At present, 42 kms of the ORR has been completed and the balance length of road connecting Bannur Road to H.D.Kote Road is yet to be taken up.

Details about the existing features of some of the important roads are highlighted in the subsequent paragraphs:

HUNSUR ROAD

This is one of the major radial roads located on the North-West side of the city. The road is mainly undivided carriageway. The carriageway width varies from 7m at intersection of ORR to 9m at CFTRI. The land use is mainly commercial with some stretches being residential. The terrain is mostly flat and at some location, it is rolling. There are no service roads along this stretch. Footpaths are not available. Hunsur road intersects ORR near Vijayanagar area, which is at present four lane divided carriageway. The road from intersection of ORR extends upto CFTRI campus near Jaladarshini. Along this entire stretch, there are two major junctions' viz., Paduvarahalli Junction and Hunsur Road – Temple Road Junction. Near Paduvarahalli Junction, Manasagangotri campus is located Kukkarahalli Tank.

BANNUR ROAD

Bannur Road is one of the main arterial roads of Mysore city which is an undivided carriageway. The carriageway width varies from 4.5 m to 9.3 m. The land use is mainly commercial. Bannur Road intersects ORR near Alanahalli layout. Beyond ORR towards Bannur side, Vidya Vikas Engineering College is located. Towards the city from intersection of ORR and Bannur Road, Teresian College is located near Siddartha Layout. Beyond Siddartha Layout, T. Narasipura Road extends upto Nazarbad Circle and reaches Hardinge Circle via Nazarbad Road. The carriageway width between T. Narasipura Road and Nazarbad Road varies between 5.5m and 9m. Karanji Tank is located near Siddartha Layout adjacent to T. Narasipura Road. Foothpath is unpaved. From the intersection with ORR, there is one major junction viz., Nazarbad Circle, Nazarbad to Hardinge Circle, the road is one way.

K R S ROAD

This is an arterial cum radial road of Mysore city which connects the city to KRS dam. The road is two lane undivided carriageway, with varying carriageway width. The land use is a combination of residential and government offices/buildings. The road is not characterized with the presence of footpath. KRS Road intersects ORR near Metagalli. The existing road width is proposed to be widened to 30m. The road intersects the railway line (going towards Arasikere at grade.

BANGALORE ROAD

This is an important radial road of Mysore city attracting heavy traffic, both personalized, buses a well as HTVs. The road is two lane undivided carriageway.

Footpath is partly paved and partly unpaved. The land use is semi commercial and partly residential. The New Bangalore – Mysore Road insects the old Bangalore – Mysore road near old check post junction, from where there is the deviation of Bangalore road. Beyond old check post junction, the road towards the city is characterized by the presence of two junctions, viz., Millennium circle and Tippu circle.

MAHADEVAPURA ROAD

The road is a main arterial road, which is four lane-divided carriageways. Footpath is about 1m and is unpaved. The land use along the road is either residential or commercial on one side while on other side, it is open space / Agricultural land. The road intersects ORR near Sathgally II stage. Along this road, near K.N. Pura, Udayagiri Circle exists. The road is proposed to be widened to 30m.

This road connects Mysore city to the famous pilgrimage Town centre of Nanjangud. The road is a two lane undivided carriageway. The land use is residential upto city limits and beyond that, it is open and agricultural land.

Foothpath is unpaved and width of foothpath is only 0.9m. On one side of the road, beyond JSS College, Sri Ganapathi Sachidananda Ashram is located, which attracts tourist population. The road is two lane undivided. The land use around this road is either residential or commercial.

The road runs almost parallel to the Mysore – Chamarajanagar meter gauge railway line upto certain distance and near Nachanahalli Palya the railway line passes over the road.

CSTRI campus is located near Srirampuram village on the outskirts of the city and close to ORR.

C. Options, challenges & recommended Solution

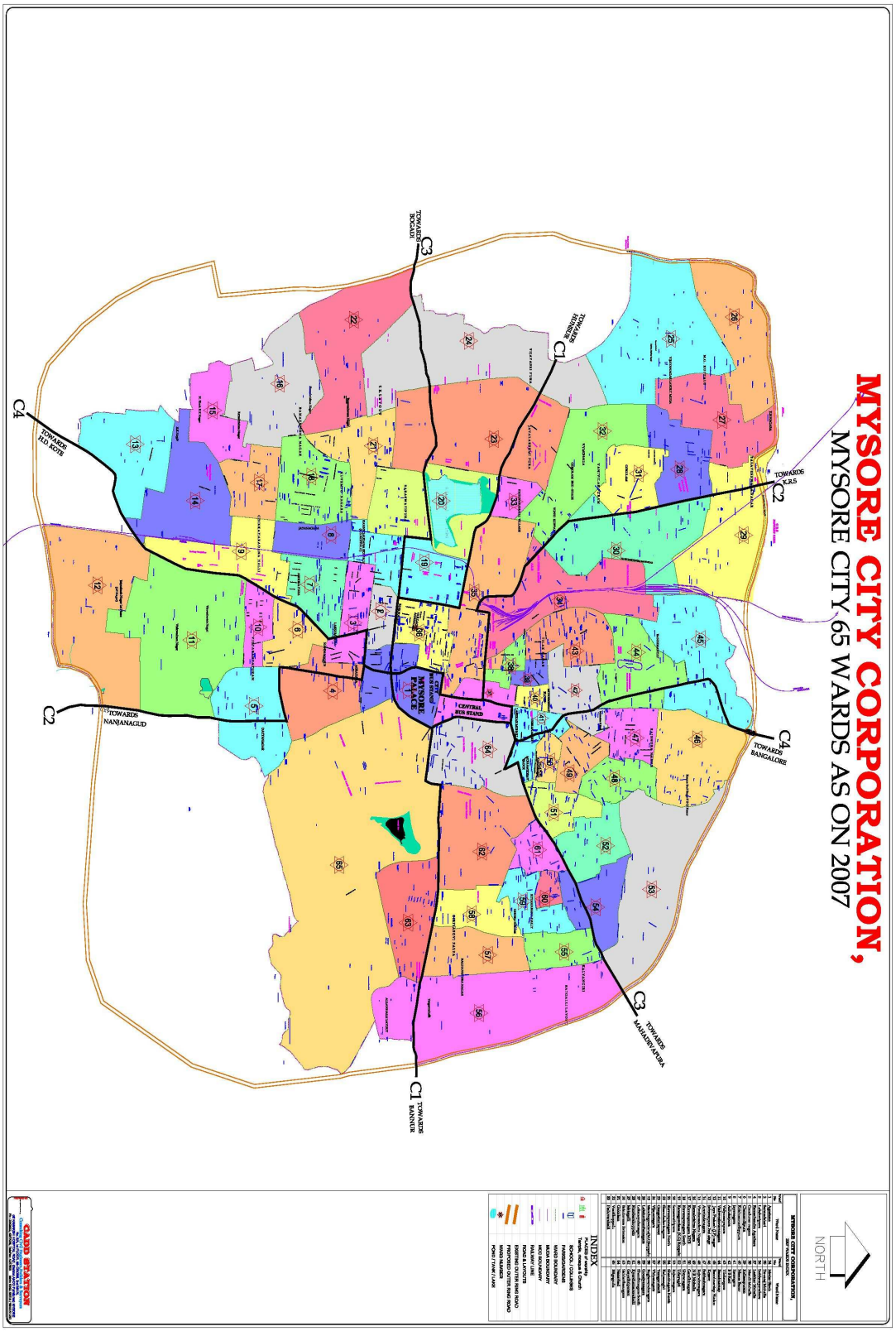
C-1. Integrated urban land use and transport planning

C-1-a. Mysore City Urban Land Use

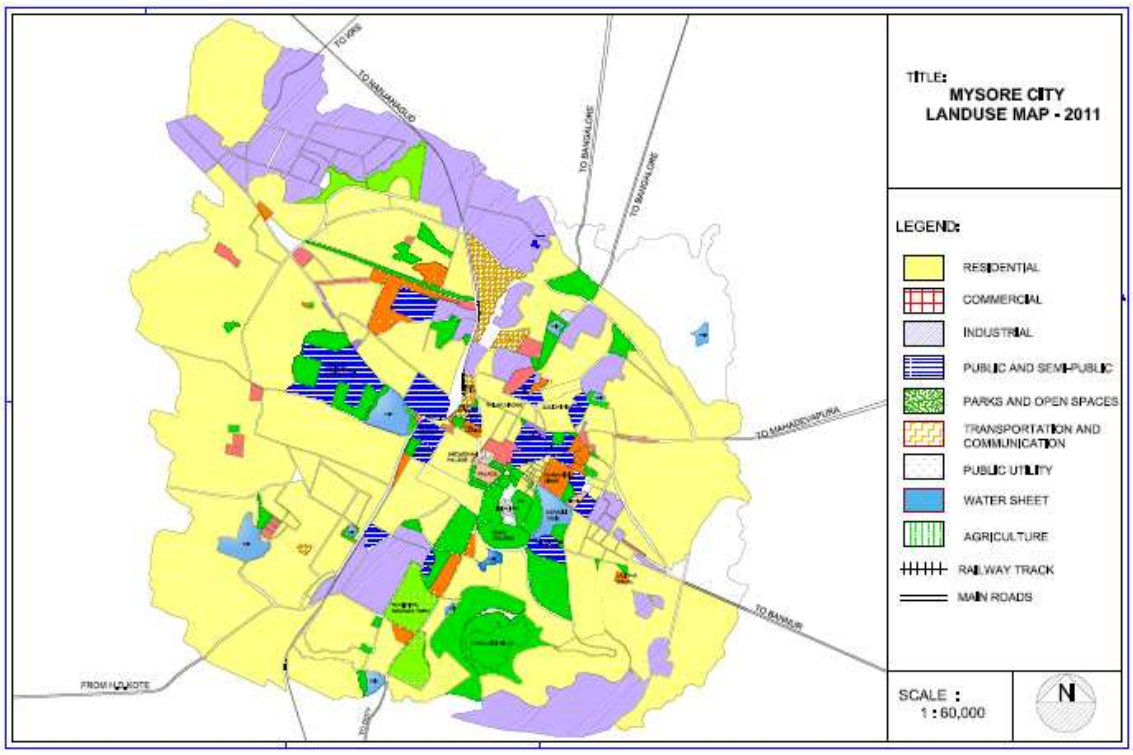
The total area for Mysore city as per MUDA has shown an increase to 9221 hectares in 2001 from 7569 hectares in 1995, representing a growth of 22%. As per MUDA, the total area is further expected to increase to 15669 hectares by 2011, representing a significant increase of around 70 % over the total area in 2001. The city's growth in the recent years has been skewed towards southern Mysore i.e the industrial areas located in Nanjangud. MUDA/ private developers have developed new layouts in the areas of Vijayanagar and J.P. Nagar. Besides, the residential layouts, private developers also have lined up an array of proposals to develop malls, convention centres and golf course. MUDA has also proposed to develop few residential layouts in the north east part of Mysore towards Bannur / T.Narsipura like Shastri Nagar. The following table illustrates the land use pattern of Mysore city from 1995 to 2011:

Category	1995		2001		2011	
	Area in Hectares	% Area	Area in Hectares	% Area	Area in Hectares	% Area
Residential	3,057.30	40.4	2,849.91	39.9	6,097.87	43.45
Commercial	182.23	2.41	215.95	3.02	344.07	2.45
Industrial	1,021.01	13.4	962.61	13.48	1855.05	13.22
Parks & Open Spaces	415.77	5.49	981.7	13.74	1055.05	7.52
Public & Semi-public	856.45	11.32	639.69	8.96	1,180.78	8.41
Traffic & Transportation	1,530.73	20.22	1,150.27	16.1	2,380.56	16.96
Public Utility	285.34	3.73	36.48	0.51	43.35	0.31
Water Sheet	182.68	2.41	143.99	2.02	178.95	1.27
Agricultural	285.34	3.73	162.33	2.27	898.99	6.41
Nehru Loka			2,078.14		1,634.82	-
Total	7,568.77	100	9,221.07	100	15,669.49	100

The total area demarcated for parks, open spaces and Nehru Loka (green spaces) is expected to decrease marginally to 2690 hectares (2011) as per the proposed land use pattern for the year 2011. Currently, this is around 3060 hectares (2001). The area allocated to Nehru Loka is expected to help preserve the green spaces around the Chamundi Hills area. The total area demarcated for residential purpose is expected to increase as new residential layouts are coming up. The residential area is estimated to be 6098 hectares in the proposed land use pattern for 2011. This would represent an increase of almost 114% over the area of 2850 hectares in the land use pattern for 2001.


MYSORE CITY CORPORATION,
MYSORE CITY, 65 WARDS AS ON 2007
NORTH
INDEX
C1
C2
C3
C4
TOWARDS BANNUR
TOWARDS NANJANAGUD
TOWARDS BANGALORE
TOWARDS MADAKARIYAPURA
TOWARDS OOTY
TOWARDS K.R.S
TOWARDS OLD KOTE
MYSORE PALACE
CENTRAL BUS STAND

The percentage of land for agricultural purpose is also expected to increase from 2.27% (162 hectares) in 2001 to 6.41% (899 hectares) in 2011. However, the percentage of area for commercial, industrial and traffic/transportation purpose has not varied over the three periods, as illustrated in the land use table above.



C-1-b. Transport Planning integrating land use

INTRODUCTION

There is a need to clearly define transportation policy for a city, especially one which has been showing tremendous increase in its population as well as vehicle growth. The conventional way of dealing with transportation problems will have to be dispensed and a comprehensive policy is required to frame a vision. The catastrophic failures of transport policies on many fronts have led the cities to revolutionalise their current positions and adopt radically new policies.

This re-orientation in thinking has not gained momentum in India while the same is being duly advocated abroad by traffic and transportation planners, with spectacular results. Hence, there is a need to formulate "TRANSPORTATION POLICY" for Mysore to ensure an effective and efficient transportation system in the city.

NEED

Over the next few years, Mysore city which has been a centre of tourist attraction is likely to develop into a major IT hub of the State. With such growth and development of the city, Mysoreans should be able to enjoy a good quality of life. Towards this end, the city should be planned and the challenges and problems faces the city should be met with utmost care. Although, some measures have been initiated by MUDA with the construction of Outer Ring Road (ORR) in the city, there is a need to provide more road infrastructure facilities. The time is now ripe for planners to become visionaries. The ideas or proposals should not be brushed aside as invalid or impractical. There will be many obstacles and difficulties - fiscal, political and practical but instead of excuses, the planners need to face reality and become more solution centred. This may lead to making decisions which may not be acceptable initially.

Planners and decision makers of the city must ensure that the public do not spend hours in traffic snarls. It is necessary to preserve the heritage, culture, history and landmarks of the city. The science of traffic and transportation underlies social, economic and environmental issues concerning every citizen. The vision for the city is directly related to the issue of mobility and the manner in which it is addressed.

PROBLEM IDENTIFICATION

The most visible problems Mysore faces are:

- Congestion, with ever increasing commuting times and delay
- Degraded air quality which threatens the health of citizens
- Lack of proper parking facilities
- Lack of proper pedestrian facilities to ensure safety of pedestrians.

It is also observed that the vehicles in the city have grown from 6000 in 1970 to 3.55 lakhs during 2006. This has happened due to the lack of efficient public transport system in the city. The increase in vehicle population has also given rise to high accident rate in the city. It is thus clearly evident that the ever increasing number of vehicles not only accelerates pollution but also leads to increased frustration and traffic violations by the road users.

FRAMEWORK FOR SOLUTION

For urban areas to be able to support the required level of economic activity, facilities must be provided for easy and sustainable flow of goods and people. Unfortunately, such a flow of goods and people has been facing several problems, most prominent among them being:

- Billions of man hours lost with people struck in traffic. The primary reason for this being the explosive growth of vehicular traffic coupled with limitation on road space availability.

- Cost of travel has increased considerably. This is largely because of the use of non-motorized vehicles like cycles and walking has become extremely risky as these modes have to share the same ROW with motorized vehicles.
- Travel in city has become risky with more accidents.
- Rapid motor vehicle growth has led to severe air pollution, adversely affecting the health of people and quality of life.

Unless the above problems are tackled in the right earnest, poor mobility can become a major dampener to the economic growth and deteriorate the quality of life. Thus, a policy is needed to deal with this rapidly growing problem and also offer a clear direction and framework for future action.

Thus, the vision of the Transportation Policy should be able to □make the city liveable and enable them to become the "ENGINES OF ECONOMIC GROWTH" □allowing our cities to evolve into an urban form that is best suited for the unique geography and support the main social and economic activities that take place in the city.

C-1-c. Objectives of Transport Policy

The objective of transport policy is to ensure safe, affordable, quick, comfortable, reliable and sustainable access for the growing number of city residents to jobs, education, recreation and other needs within the city. This is to be achieved by:

- Incorporating urban transportation as an important parameter at the planning stage
- Encouraging integrated land use and transport planning so that travel distances are minimized.
- Bringing about an equitable allocation of road space with people and vehicles, as its main focus
- Investing in transport systems that encourage greater use of public transport and non-motorized vehicles rather than personalized motor vehicles
- Establishing regulatory mechanism to allow a level playing field for all operators of transport services
- Introducing Intelligent Transport System for traffic management and increasing effectiveness of regulatory and enforcement mechanisms
- Addressing concern for road safety and reducing pollution levels through changes in travelling practices, better enforcement, stricter norms, technological improvements etc.
- Promoting use of cleaner technologies
- Associating private sector in activities where their strengths can be tapped beneficially

Thus, the responsibility for management of urban areas and urban transport rests with the State Government. The transport policies to be formulated being compliant with the National Urban Transport Policy (NUTP).

REALIZING POLICY OBJECTIVES

The objectives of the transport policy should be achieved through multi-pronged approach. This can be achieved by:

- Integrating land use and transport planning
- Equitable allocation of road space
- Priority to use of public transport
- Priority to non-motorized transport
- Discouraging use of personalized motor vehicles
- Providing parking facilities
- Providing facilities for freight traffic
- Coordinating planning and management of city transport
- Using cleaner technologies
- Innovative financing mechanism using land as a resource
- Association of private sector
- Creating public awareness and co-operation

INTEGRATING LAND USE AND TRANSPORT PLANNING

The transport system of the city depends on population, area, urban form, topography, economic activities, income levels, growth constraints etc. Transport planning is intrinsically linked to land use planning and both need to be developed together to serve the entire population and minimize travel needs. Due attention need to be paid to channel the future growth of the city around pre-planned network rather than developing a transport system after uncontrolled growth. Hence, transport plans should enable the city to take an urban form that best suits the geographical constraints of its location. It is therefore imperative to promote development of integrated land use transport plans. Thus, MUDA in association with MCC and other transport authorities should set up a "TRANSPORT AUTHORITY", which would exclusively look after the transport requirements of the city. The authority shall develop the land use and transport planning parameters.

To this effect, assistance up to 50% would be provided by the central government. Hence, the city should be encouraged to identify potential corridors for future development and then establish a transport system that would encourage growth around itself. Radial corridors emerging from the city and extending up to 20 – 30 Km count be reserved for future development. To this effect, MUDA has initiated action by constructing Outer Ring Road (ORR) on the periphery of Mysore city, which is about 6 Km (avg.) from the city centre. In the next few years, the areas around ORR would develop and transport authorities can plan to provide services to these areas. It is however very essential for MUDA to ensure that these areas are protected from encroachment by putting up physical barriers.

Central Government provides partial financial support for traffic and transport studies in such cities. Mysore can utilize the facilities under this scheme of central government so that broad based studies could be undertaken to integrate transport planning with land use planning, keeping projected populations in mind.

COMMERCIAL DEVELOPMENTS

The city has been witnessing a spate of commercial developments. This has resulted in generation of high volume of traffic, especially during peak hours. Access from and to these commercial establishments is creating traffic snarls with impact on other traffic. It is important that the local administration viz., MCC & MUDA take an active role while sanctioning construction of commercial establishments.

TRAFFIC DEMAND MANAGEMENT MEASURES

It is a known fact that with the growth in economy people tend to become more affluent resulting in an increase in ownership of personalized vehicles. To cope with the increase in personalized vehicle, efforts should be made by the concerned local administration to improve the road infrastructure facility. This is the general tendency witnessed in almost all cities in India and Mysore is no exception to this rule. The growth in the vehicular population outstrips the advantage from the improved infrastructure. Hence, it is very essential and critical to limit the number of vehicles on roads. The only prerogative to achieve this is to improve the public transport system thereby attracting more people to use the services.

PARKING

Land is a valuable asset in urban areas. Parking lots occupy large portion of such land. Hence, such land should be recognized in determining the principles for allocation of parking space. As the number of vehicles in the city explode, the demand for parking lots increases resulting in utilisation of available spaces meant for other road users as well as creating a demand for all available open spaces to be turned into parking lots. This trend has already begun in most of the cities in our country.

There is an urgent need to formulate policy for parking. Rather than having a reactive parking policy which constantly changes with ever increasing number of vehicles, the policy should aim at reduction in the need for parking.

FORMULATION OF PARKING POLICY

The following guidelines are recommended for creating a comprehensive parking policy for Mysore City.

- Limit availability of parking space and levy high parking fee in order to curb the use of personalized vehicles.
- Preference in allocation of parking space for public transport vehicles

- Introduction of graded scale of parking fee that covers the economic cost of land used in such parking lots. This would help in persuading people to use public transport to reach city centres and restrict the use of personalized vehicles to city centres.
- Multi-level parking complexes should be made mandatory in city centres that have high-rise commercial complexes.
- Parking complexes should come up with PPP so as to limit the impact on public budget.
- Parking complexes should also go in for electronic metering so that there is better realization of parking fee.
- Provisions should be made by appropriate legislation to prevent use of ROW on road systems for parking purposes.

When large share of trips are met by public transport system, the IPT modes become important to fill the gaps left by public transport. No space is earmarked for parking of these modes resulting in parking of these vehicles on roads creating major obstruction to traffic. Hence, necessary measures should be taken to ensure that sufficient space is allocated to the IPT mode, especially at railway stations and bus terminals.

FREIGHT TRAFFIC

With the city's expansion and population growth, substantial amount of freight traffic would be generated. The timely and smooth movement of freight is crucial for the economic activities undertaken by the residents of the city. With limited road capacity available, it is essential that passenger and freight traffic are so staggered to make optimum use of transport infrastructure. Thus the off-peak passenger travel time can be used for freight movement. The entry of HTV should be banned during daytime. Already a truck terminal has been constructed on Ooty Road near RMC yard. On completion of the ORR, arrangements should be made to construct more terminals along the ORR so that the entry of freight traffic to the city can be minimised.

C-1-d. Modal Shift to more efficient and less polluting forms of Public Transport

PRIORITY TO PUBLIC TRANSPORT SERVICES

Public transport generally occupies less road space and causes less pollution per passenger-km than personalized vehicles. Public transport is a more sustainable form of transport. Hence, local authorities should promote investments in public transport and make its use more attractive than personalized vehicles. Towards this end, the central government also encourages each city with a population of more than 4 million to plan for Mass Transit System that would best suit the city requirements in the next 20 to 30 years.

TECHNOLOGIES FOR PUBLIC TRANSPORT

There is a wide spectrum of public transport technologies. High capacity, high cost technologies like metro systems and low capacity bus systems running on shared ROW are the two extreme options available as of now. Within these two extremes, there is a range of intermediate possibilities like buses on dedicated ROW, elevated sky bus, monorail, Electrical Trolley buses etc.

Improvement to existing bus system in the city is achieved by:

- Improving / enhancing the current fleet. This means more buses and better-maintained buses, well-maintained bus terminals.
- Providing better training and management to staff so as to improve their ability and morale
- Introducing hierarchical system, which consists of buses with different levels like express buses, peak hour service buses (akin to the system prevailing in Bangalore), limited stops buses.
- The improvement to bus fleet will improve commute time, comfort and reliability for current users. This will reduce the pollution risk to commuters and non-commuters. Hence, these measures must be undertaken immediately.

USE OF CLEANER TECHNOLOGY

Petroleum based fuels are the most commonly used products for vehicular traffic. New Delhi has adopted CNG while some other cities have also switched over to CNG. However, the pollution level at Mysore has still not reached alarming proportion. "Prevention is better than cure" is the famous adage and the same principle can be applied to Mysore in the current scenario.

Rather than taking action after sufficient damage is done to the environment, it is always better to take preventive measures before the situation goes out of control. Towards this effect, cleaner technologies need to be encouraged so that the problem of vehicular pollution can be more effectively tackled. Thus, the public transport system in Mysore should be augmented in the right earnest so that the usage of personalized vehicles can be minimized.

C-1-e. Provision and encouragement of non-motorized transport

PRIORITY TO NON-MOTORIZED TRANSPORT

Non-motorized transport has lost its importance due to the increasing sprawl and rising income levels. It is seen that the share of bicycles on an average in Mysore is about 11% (average) of the total volume of traffic. Longer trip lengths and sharing of a common ROW with motorized vehicles have made the usage of bicycles more risky and difficult. However, the non-motorized vehicles are environment friendly and have to be given their due share in the transport system of Mysore city

DISCOURAGE USE OF PERSONALIZED VEHICLES

The measures to be taken to discourage use of personalized vehicles should go hand in hand with the measures that seek to encourage use of public transport. Towards this end, the State Government / MCC / MUDA should encourage people to use public transport or non-motorized transport (for shorter trip lengths) and limit the use of personalized vehicles.

This could be achieved by:

- Providing efficient and effective public transport services covering all the areas and localities of the city.
- Improving road infrastructure like widening roads, strengthening the pavements
- Providing facilities at bus terminals and bus stops which would encourage more usage of public transport system
- Reducing the waiting time for public transport

C-2. Analysis of current technology solutions

C-2-a. Worldwide experience of Real Time Passenger Information Systems

Real time at-stop information is probably the one, which best meets user expectations. At-stop displays usually display waiting times. Also, the location of the arriving vehicle can be shown. The knowledge of waiting time greatly improves the conditions of the trip in two main ways: (i) by removing uncertainty (When will the bus arrive & Has the bus already passed) (ii) by minimising waiting time (passenger is enabled to do shopping, etc).

REVIEW OF INFORMATION SERVICES

Most of the at-stop displays surveyed here were bus stop displays. In addition, there were some metro platform and train station display systems surveyed, but the conclusions mostly concentrate on bus stop displays.

Existing at-stop displays provide real-time information on the arrival of the next vehicles. The content of the given information is usually the same: route number, destination of the arriving vehicle and waiting time. Some displays show the location of the arriving vehicle on a linear map. About half the systems give information on service disruptions. The Metro platform displays in Helsinki give information about the vehicle: they use a symbol to display the length of the train. The most common additional information is current time, some displays can give free text messages.

REVIEW OF ERGONOMIC ASPECTS

Almost all the bus stop displays are situated in the direction of the arriving vehicle. In those cases the vertical position of displays varies between 170 and 250 cm above ground. The vertical position is limited by the height of the bus shelter.

The way to give the same information (on waiting time) varies among systems. Most bus stop displays show the next 1 - 5 lines / vehicles at a time one below the other. The number of lines shown can be varied: the bottom row can scroll or all text can scroll on the display. On some displays the route number is static information and so all the lines passing a certain stop are displayed continuously. VIDEOBUS in Le Havre, France, has a diagrammatic representation: the waiting time can be seen in the same screen as the progress of the arriving bus.

The use of LED and LCD displays is about the same. The height of text in the different systems varies from 2.9 to 7.5 cm. Font type is usually undefined (though in some systems it is arial.)

The needs of elderly and disabled people have been taken into account in about 25% of the systems surveyed. The most common way of catering for the needs of elderly people is to transform the text information into audio information. This can be done, for example, with key fobs that have been issued to blind persons. With a key fob, audio messages giving the same information as the sign, can be activated. At some stops there is also a button that a blind person can push to request information from the Control Centre by radio. Other features used are larger letters and contrasting colours for the signs.

Two portable information devices for blind or partially-sighted people are currently under test in the UK, which offer the potential for improving the specificity of information provision in-trip for disabled or elderly people. One is the REACT wayfinder system, currently under test at Golders Green Undergound station, London. The user carries a small device that triggers speech from a beacon when the user comes into range, and the system is automatic and does not need to be activated by the user: it uses radio technology.

The second experimental system is Pathfinder, using infra-red technology. This requires the user to point the device at the receiving beacon, and it then triggers a message to the user through an earpiece. A trial of the Pathfinder system is currently being undertaken at Hammersmith Underground and Bus Interchange, in London.

All the displays have been protected against vandalism somehow: with strong metal cases, poly-carbonate fronts and anti-graffiti coatings.

DATA TECHNOLOGY

Data communication between the vehicles and the control centre is handled by radio in all the systems on which the information was available, except in STOPWATCH (UK) where a radio paging system is used. Data communication between the control centre and the signs mostly uses radio, although pager, wire and telephone are also used. Vehicle positioning uses beacons, GPS, DGPS, dead-reckoning, track circuits, odometer and different combinations of these technologies.

C-2-b. Surveys and Experience

Surveys have been carried out, among other places, in Brussels, Glasgow, Birmingham, London, Bologna and Paris. Feedback has also been received in other cities, and the overall customer response has been very positive.

Surveys in **Brussels** show user satisfaction on PHOEBUS to be 90 %; the systems are regarded as being very user-friendly, and display readability is felt to be excellent. The Brussels experience is that the use of public transport on the lines equipped with these displays has increased by 6 %.

In **Glasgow** (BUSTIME) user feedback in surveys has been extremely positive. There is 98% acceptance, and 46% of users say that they would be encouraged to use the bus service more often because of the system.

In **Birmingham** (CENTRO) household surveys asked what measures were required to get people on to buses and out of cars. Real-time information on PT was considered the best, more important than, say, improved bus shelters or low floor vehicles. Passenger numbers have gone up 30 % after the introduction of combination of measures on a demonstration route (including CENTRO displays).

In **London** a pilot survey has been carried out on one COUNTDOWN route, and gave very positive results. The main findings were that:

- Waiting itself is more acceptable (89% of passengers)
- Passengers found that time seemed to pass more quickly when they knew how long their wait would be (83% of passengers)
- Passengers perceive a shorter waiting time (65% felt this was so)
- The service is perceived as more reliable
- Of those passengers travelling, waiting at night is perceived as safer
- General feelings improve towards bus travel (68%), the particular operator (54%) and London Transport (45%)
- 96% of passengers say that Countdown information is clear and easy to see, and have no problem of any kind with the system
- About 70% of passengers refer to the display when they arrive at the stop, and about 90% look at the sign while they wait. About 60% say they look at the sign at least once a minute.
- Passengers approve of the 3 essential pieces of information provided (route number, destination and waiting time). However, some base-line messages sent out by Countdown controllers were not so well understood.
- There is strong overall customer support for the system
- Countdown has been found to generate a minimum of 1.5% new revenue.

A survey was also carried out on the Time-checker system in **Liverpool** (where the system itself has been funded under the European THERMIE and DRIVE II projects). The results, which were very positive, are as follows:

- The Time-checker system has led to a 5% increase in patronage on routes where Time-checker had been installed.
- 68% of passengers use Time-checker consistently
- The system claims a 90% accuracy
- 85% of users believe that the use of Time-checker makes waiting more acceptable
- 87% feel that Time-checker gives a feeling of reassurance
- 92% of respondents perceived real-time information to be either 'very accurate' or 'accurate'
- 89% of respondents wanted to see an expansion in the provision of real-time information, with electronic displays provided at all bus stops ·
- 73% of respondents found that the availability of real-time information enhanced their feeling of personal security when waiting for a bus after dark.
- 71.5% of users believed that, in general, the SMART services improved when the electronic displays were installed.
- 57% of respondents thought that the installation of real-time displays resulted in decreased waiting times at bus stops.

In **Espoo** (Finland) a passenger survey has been carried out before and just after the installation of the displays. Passengers' views on the system are mainly positive and the system is more widely accepted after than before the implementation. The main findings from the survey made soon after the implementation are:

- 78 % of the passengers interviewed consider the system good or very good, just 5 % are of opposite opinion. A total of 78 % support the expansion of the system, 22 % object to it.
- The displays are already now used more than paper schedules. Fewer people find out the departure time of the bus beforehand (compared with the study made before implementation).
- Critical feedback on the system was mainly focused on unreliable waiting times shown on the displays. The result was expected at this stage, because 90 % of the waiting times shown on displays are based on driving times from 1995.
- 91 % of the passengers interviewed understood correctly the times shown in display. The bus symbol was understood by 62 % of the passengers. The square symbol was understood by 38 % of passengers. (There are posters at the stops to explain the display characters.).

OTHER EXPERIENCE

The general experience of the systems is that they work very well and are very useful and successful. However the implementation stages of some systems have had difficulties. There have been problems with installations and deliveries have been delayed.

Installation of COUNTDOWN (**London**) has been dependent on installation of AVL (Automatic Vehicle Location), which has been delayed due to, e.g.

- Longer-than-anticipated integration of the various AVL system elements
- Bus fleet 'churn' (moving buses between depots)
- The change in scale required from project to programme working.

- The one major operational problem with the AVL system is bus drivers not registering their vehicle onto the system properly. This is a major challenge to the perceived accuracy of COUNTDOWN, with up to 15% of vehicles not showing on the signs.
- Several developments are being considered to enhance Countdown: e.g.
- Linking the buses' radio to the Electronic Ticket Machine, to assist driver logging-in
- Evaluating ISDN for landline communication to and from the stops
- Initiatives to allow third-party dissemination of Countdown information.

In **Southampton** (STOPWATCH) there have been operational problems with waiting time predictions, while in **London** (COUNTDOWN) the accuracy of predictions is high: forecast errors in 1997 surveys were within + or - 30 seconds for 40% of the time. On average, over all predictions, 75% of the time forecast errors are within + or - 2 minutes. On average 65% of 'clear downs' from the stop display are within + or - 30 seconds of the bus being at the stop, and 83% are within + or - 1 minute.

Mersey travel (the co-ordinating agency in **Liverpool**) found that with high demand for radio channels from other users, obtaining suitable radio channels to operate the system was one of the biggest barriers to implementation of the Time checker system.

Whilst it is relatively easy to make changes to the database of timetables and running boards, a major problem has been that with the system Time checker uses, each morning the bus operator must enter the fleet number and running board for each bus into the system, otherwise the system does not know what buses are on the route. It has not always been possible to obtain the manpower to do this, so that at times this has had a detrimental effect on the reliability of the system.

In **Hong Kong** (PIDS) the stop display system (in use on the Metro network) is considered to enhance the safety of the underground environment by providing information efficiently and to be an effective tool in assisting crowd control.

In **Gothenburg** there is a lot of experience on at stop displays. The GoTiC project has produced research reports on requirements and recommendations for real-time displays and design of information about disturbances in public transport. Some findings concerning the display type (GoTiC News 2/97, Research report of GoTiC project: Recommendations for real-time information on monitors and displays, 1995):

- LED technology is especially well suited for locations where shelter roofs shield the displays from excessive sunlight. LCD technology provides good legibility, even in sunlight.
- Binotype, a special binary typeface, has been developed to make message texts on binary interfaces (LED; LCD, bi-stable) as legible as possible. In the study the

majority were of the opinion that the sign with red text on a black background was easiest to read. In order for a LED display in a shelter to function properly as a carrier of real time information, it must be able to display at least four lines of 35 characters per line.

- An advantage of the monitor is that it has space to provide a good overview of available alternatives of the various lines passing the stop. The disadvantage is that the monitors are very light-sensitive. Outdoor monitors for real time information should be avoided.

Users of monitors may have problems related to readability and outdoor positioning. Finnish Railways and display supplier have found a new solution to replace monitors with displays with a developed LCD technique. They are easy to place (the depth of the device is only 10-20 cm) and the readability is much better than with monitors in a daylight. They are also cheaper than outdoors monitors. Experience on use is however not yet available.

SIMILAR PROJECT EXECUTED IN ROME.

The ITS Project in Mysore is modelled on many similar projects in operation world wide. Mysore project can be linked to its similarity to the ITS Solution for public transport in Rome.

The latest system for Public Transport management implemented in the city of Rome is called the 'Automatic vehicle monitoring'. This system serves the fundamental tool for managing all the processes in Public Transport Service, planning, control, passenger information and production control.

The components of the System Architecture are the on board system, the depot system, electronic display system, communication system and central control system. All the data & information collected by the system can be used to support the different stages of the Service supply chain:

Planning

- Estimated route journey time Vs real route journey time.

Monitoring

- Real time mapping of buses on routes and information on the status of the vehicle.
- Real time information on vehicle's Service details, location, speed etc
- Real time information on bus stop details such as missed bus stops.
- Passenger Information System
- Real time location of the buses with respect to bus stops and delays estimated on the arrival time at bus stops.

Control room functions

- Linear representation of bus routes and bus stop details.
- Visualization at the control center of the information delivered on the electronic displays.
- Automatic record and reporting of data for operation and management personnel.

C-3. Analysis and Recommendation of the Solution framework

Mysore as location for ITS implementation "*Enhancing the glory of Mysore, and enabling it to forge ahead as the cultural, tourism, educational, and wellness hub*" is the vision of Mysore. The Principal Secretary, Department of Industries and Commerce, has said that Mysore is all set to witness rapid industrialization with the Government sanctioning 55 medium- and large-scale industries, which will create 60,000 jobs over the next few years.

The Government of Karnataka is promoting Mysore as an alternative destination for the Information Technology (IT) industry and developing it as a counter magnet city to Bangalore. As a result the city has become a new haven for the IT and Information Technology Enabled Services (ITeS) industry and is poised to play bigger role in the economy of the city. This is apparent from the fact that the software exports from the city grew at 26.8% to reach Rs.392 crores, in the year 2005-06. As the divisional headquarters of Mysore Division and as the Railway Junction, railways are the other major employer in Mysore.

The Government has cleared 55 industries under the single-window agency scheme for Mysore. This envisages an investment of Rs. 9,462 crores.

With the State Government marketing Mysore as a potential destination for investment in the manufacturing and services sector, the Karnataka Industrial Area Development Board (KIADB) is in the process of acquiring 3,872 acres of land to open 1,000 industrial units in and around Mysore.

Besides, the 154 acres of land being acquired for the airport at Mandakalli near here, KIADB is also acquiring 257 acres of land for a textile park at Kadakola, 658 acres of land at Hootagalli, 500 acres of land at Anchya, besides 1,500 acres of land at Thandya in Nanjangud.

Improvements in infrastructure, like doubling of Railway tracks, completion of the four lane State-highway, the Bangalore - Mysore Infrastructure Corridor (BMIC) between Mysore and Bangalore, up gradation and expansion of the Mysore Airport will bring significant growth to the economy of Mysore. The congestion in Bangalore, as well as its proximity, is having a 'push effect' on IT/ITeS industry to Mysore. The city's share in the State GDP at 7.09% (1996-97), has exhibited a marginal increase over the figure of 6.63 % (1980- 81). However, with the IT companies establishing their bases in Mysore in the recent years, the city's share in the state GDP is expected to improve. The population of Mysore, which was around 8 Lakhs in 2000, is projected to touch 25 Lakh by 2030.

Learning from the examples of other cities where traffic congestion has been a major factor, Mysore proposes to build on these learning, while the economy is poised to

grow significantly, through proactive planning and providing state of the art infrastructure that would attract citizens to adopt the public transport system as the first choice of travel, helping to reduce the use of personal vehicles commuting to work, pleasure, social visit, or for commerce.

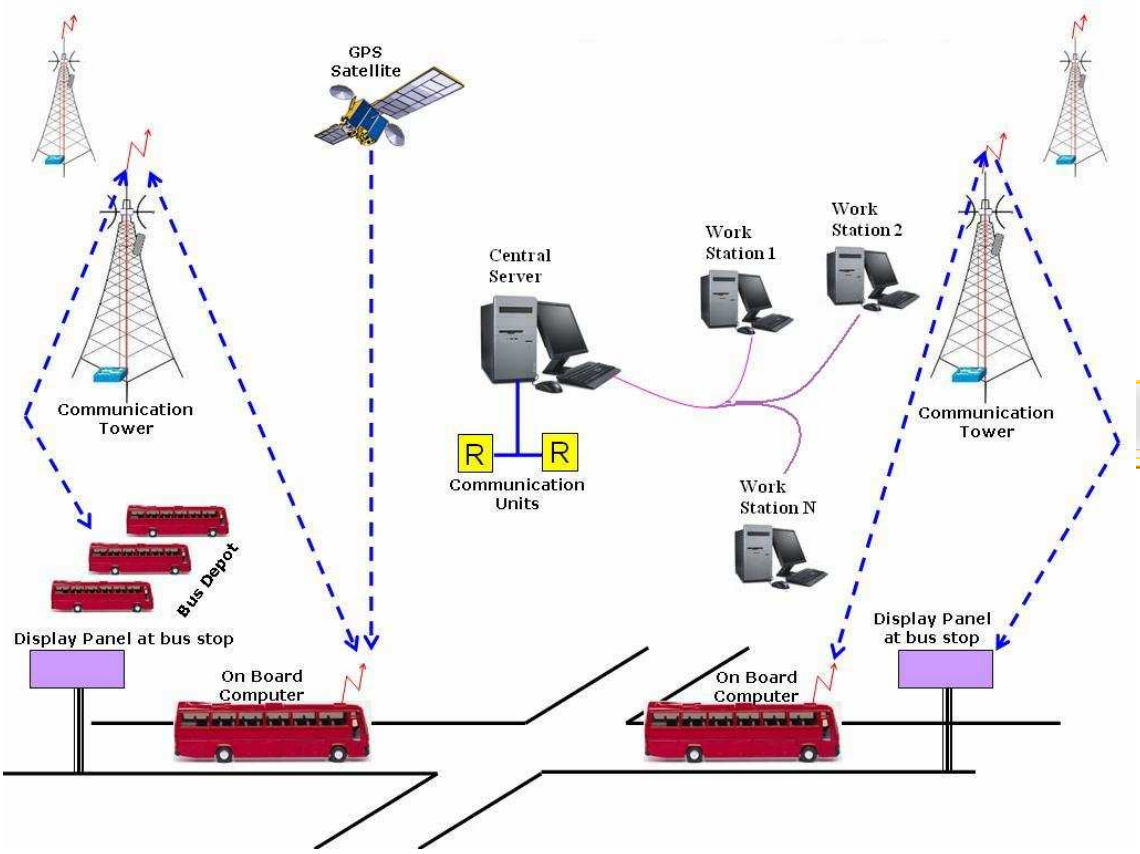
One of the most daunting problems faced by the cities in the country is that urban transport failed to provide facilities thus increasing travel time and cost both for passenger and goods traffic.

It is now well accepted that lack of adequate public transport offering comfort and convenience, has resulted in steep increase in the ownership of private vehicles particularly two wheelers with subsequent effects on pollution, both noise and air. In most cities two wheelers comprise more than 70% of total motor vehicles.

C-4. Solution framework architecture & design

C-4-a. About Intelligent Transport System

Intelligent **T**ransport **S**ystems (ITS) is an umbrella term for advanced automation in moving vehicles. It includes internal and vehicle-to-vehicle communication systems as well as collision avoidance and crash detection systems. ITS also covers systems that monitor traffic in order to control signal lights, electronic speed limit signs, reversible lanes and other highway safety components. One of the ultimate and futuristic manifestations of ITS is automatic vehicular guidance, which steers a car by sensors in the road.



C-4-b. Overall Scope of Service

The overall scope of the implementation will consist of design, development, testing, installation, commissioning, training, operations, and management of facilities for a period of three years by the winning bidder.

This project is planned to cover 500 Buses, 80 Bus Stops and 2 Bus Terminals. ITS is divided into the following eight components:

1. Vehicle Tracking System
2. Central Control Station
3. Passenger Information Management System
4. Communication Sub System
5. Travel Demand Management
6. Incident and Emergency Management System
7. Operational and Maintenance Specification Fleet Management System
8. Demolition and Construction of Bus Stops

C-4-c. Benefits of ITS

1. Increase the accessibility of the system
2. Reduce travel time
3. Improve traffic efficiency
4. Reduce traffic congestion
5. Reduce the fuel consumption and emissions
6. Reduce the operation cost
7. Improve environmental quality and energy efficiency
8. Increase the safety of users
9. Improve economic productivity