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# BRTS- Bus Rapid Transit System in Pune Modeling, Simulation and Feasibility Analysis

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## Abstract

The City of Pune, Maharashtra, India is well known as the city of Two Wheelers and has a large two wheeler population; Also the traffic here is prone to frequent congestions during peak hours; leading to jams causing huge delays in travel times. Moreover, pollution created by these vehicles is a huge cause of concern for the public and local authorities alike. To tackle this problem, the Pune Municipal Corporation came up with a plan to implement the BRTS in Dec. 2006, and successfully introduced it on a 13 KM stretch, becoming the first city in India to do so. This system has dedicated lanes and signaling system for Buses and thus is independent of the on road traffic, aimed at decreasing congestion and pollution by encouraging Pune motorists to take the BRTS instead of driving. The author has made an effort to compare the BRTS system with the regular one by Modeling and simulating both systems under various scenarios. Further on, the feasibility of implementing this system is discussed, along with its pros and cons, and the final section is dedicated to future developments to system and how it can be improved to make life easier for commuting Puneites.

**Keywords**
Rapid transit, transport, Pune, Modeling, Simulation, BRTS.

## Introduction

For any city to become fully functional and truly competent on both National and International levels, it is very imperative that the public transportation system is firmly in place; and also relied upon by the government and the people. This paper is aimed at modeling the traffic scenario in that part of Pune city where the BRT has been implemented, both before and after the implementation of the system. Using Mathematical modeling software, a statistical cum graphical model of the place has been created and the two scenarios have been exhaustively simulated and some very interesting facts surface as a result. Based on the simulation study and a feasibility analysis, an effort has been made to draw a conclusion about the system and its effects on Pune's society.

## Pune city

**Pune** is the eighth largest city in India, and the second largest in the state of Maharashtra, after Mumbai. The automotive sector is particularly prominent. All sectors of the automotive industry are represented, leading The Independent to cite Pune as India's "Motor City", India's Detroit. [11] Pune has a rapidly growing software industry as well, with multinational companies having large development centers. [11] Pune has more than a hundred educational institutes and nine universities, and has acquired a reputation as 'The Oxford of the East', with students from all over the world studying at the colleges of the University of Pune. Pune has more schools, colleges and universities than any other city in the world. [11] The **2008 Commonwealth Youth Games** were held in Pune, India, a city in the state of Maharashtra. Over 1,300 athletes and 350 officials from 71 countries participated in these games. [7]

## BRTS system in Pune:

The City of Pune is spread over an area of 450.69 square kilometers (Metropolitan) The population as on June 2009 is approximately 72, 24, 00, 000.[4] The number of vehicles on road is 14, 45, 364 as on Feb 2007. [5] And two wheelers count of 11, 23, 898. [5] This number is increasing at a rate of about 60,000 units every year. On certain parts of the day it might take as much as 3 hours to travel a distance of 5 Kms. within Metropolitan Pune. With all these pressing reasons on hand; and in order for the city to decongest its roads and to make it easier for the local public to commute, it was extremely imperative that the new bus system win the faith of the people initially. The

Pune Municipal chalked out a plan in May 2006 to implement the BRTS, and after the design and planning stage, it was introduced on the critical Katraj-Hadapsar section having a length of 14.5 Kms, in 2008.

## Modeling:

**1. Old model (Initial, Before BRTS implementation.):**
**Assumptions**:
Buses travel with local traffic; no direct service between Katraj & Hadapsar; 05 signals and 08 stops along the way. One bus every 45 min. Each Bus Stop takes 10 and signal 45 sec. Traffic speed Dynamic throughout the day and decreases exponentially to 12km/hr. from 20km/hr. between 7am to 9am; and increases again to 20 gradually from 2PM onwards till 9PM after which it increases further. The assumed distances are 8.7km for leg 1 and 5.8 km for leg 2.

This is the map of the initial model; when simulated from 10:45 AM (First Bus) till 8:30 PM (Last Bus), it was found that the travel times vary significantly for a person to travel from Hadapsar to Katraj.

## 2. BRTS model:

**Assumptions:** Buses have constant speed of 30 km. /hr. which is not affected by external traffic due to Dedicated lane allocation, there is a prioritized signal system in place; the vehicular traffic follows the same speeds as the ordinary model, just that in this case the buses will not be affected by that traffic; the service would be direct and no transfer at Swargate. On simulating the above model for one day; with same traffic trends as the one for old model; we found a huge decrease in travel time, which came down by more than 50% to 31:15 min (The night after 9 PM).

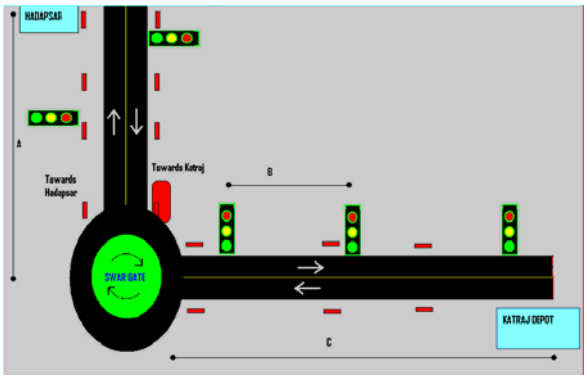


Figure 1: Model for initial situation with all parameters.

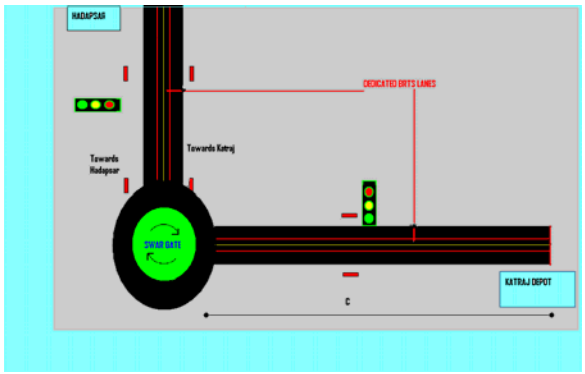


Figure 2: Model for BRTS system with all parameters.

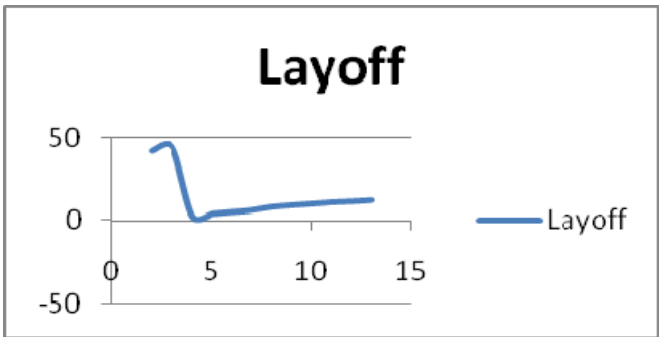


Figure 3: Layoff times at SwarGate.

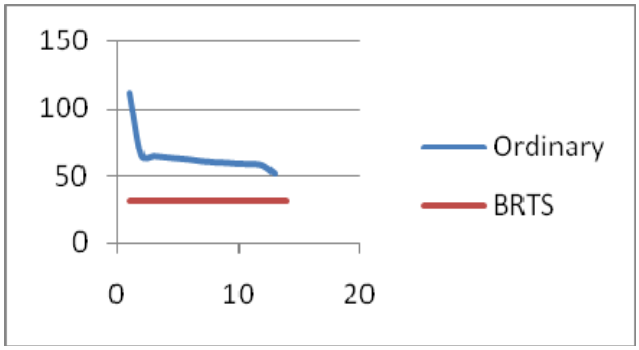


Figure 4: Comparison of travel times between both models.

**Interpretation of simulation statistics**:
On a scale of 0 to 60, these are the layoff times at Swargate which a Passenger has to mandatorily spend, before he takes the next bus to Katraj. On the other hand the question of a layoff is eliminated in BRTS due to a direct service. Also, we get a fluctuating travel time on the regular model, As seen from the two models above, it is clearly evident that the BRTS system saves a lot of travel time and also is clearly more efficient as compared to the regular model. This means that our travel times change drastically as the total travel time mainly depends on these critical things; Speed with which the traffic is progressing. Timing of connecting bus from Swargate. But, for the BRTS model both these criteria get eliminated as, the speed of the bus is a constant 30 Km/hr. independent of the traffic speeds. The service is direct and there is no need for a transfer.

One main difference between the Ordinary System and the BRTS system is that, In the Ordinary system, the driver has to drive the bus through the traffic like any other vehicle on the road, Which means he has to drive with complete alertness of Clearance, pedestrians, etc. for really long hours each day; But on the other hand, if we consider the BRTS, the driver there has a clearer job at hand, The dedicated lanes system allows him to drive on without worrying about changing lanes to reach bus stops or about pedestrians or other motorists, especially two wheelers in Pune, coming in his way. This greatly relieves driver stress and also brings down the likeliness of an accident involving a bus to almost nil.

**INITIAL RESPONSE:**
Initially the Pune public responded very positively to the BRTS system, the travel times on the section in question changed forever and common public was benefitted to the fullest. Also these was a considerable section of the public working in the IT parks, who left their cars at home to take the BRTS route. It could be seen that the traffic could come under control simply because of the fact that the buses were no longer on the road, in fact now they had their own road! The BRTS proved to be one of the highlights of Pune for the 2008 Commonwealth games which it successfully hosted. Also the PMPML which had been operating the route with a slightly increased fare was so impressed with the public response that now plans are being made to install BRTS on many other roads in the city. This initial success of BRTS in Pune opened up the avenues for BRTS within the country.

**CURRENT LIMITATIONS/SCOPE FOR IMPROVEMENT:**
Though the BRTS of the PMPML in the initial phase was a huge success, there were some areas where it could improve to do even better: The Bus Shelters were at the middle of the road, so crossing the road after Alighting or before Boarding was a big hassle, it is suggested that Over Head walkways be constructed for pedestrians to cross easily. The BRTS already uses an Information system for displaying advertisement messages transmitted via satellite; this system could be used to show current status of the bus in terms of timing and location as well as the status of buses available from the next stop. Boarding the bus is a big hassle for Handicapped Passengers, so a system could be put in place to ease travel for such special passengers. Since the lane remains unused for most of the time; other PMPML buses which are non- BRTS may also be allowed to ply on the route with a clever planning so as to extend the benefits of BRTS to them too.

**CASE STUDY: VIVA-YORK REGION TRANSIT, TORONTO:**
York region in suburban Toronto was not well connected by the TTC (Toronto Transit Commission) and hence the YRT or York Region Transit came up with the unique concept of VIVA which is a BRT system incorporating core BRTS principles and some more features like; Public-Private partnership in owning and operating the buses; Color coded route names (Viva Orange, Viva Blue etc.); Priority signaling; widened dedicated lanes; Also it has real time monitoring and ticketing at stop and on bus; Viva routes connect to Toronto Transit Commission's Yonge, Spadina, and Sheppard subway lines, and to a number of Toronto bus routes. Viva is integrated with YRT's existing bus network, and passengers are able to pay one fare to use both Viva and the regular bus system.

The system has dynamic ticketing where the ticket has to be purchased for number of rides rather than the distance travelled; and also the system has a coupon validating facility for prepaid rides; There is also a transfer facility where if one is transferring between two routes one can purchase a ticket and a transfer instead of two tickets which obviously cost more than the transfer.

The buses have special ‘Kneel’ capability for the benefit of handicapped passengers and also voice announcements for each approaching stop.

With a total of 5 routes having 59 stations and operating a total of 90 buses with a 3 minute average frequency on every route; VIVA-YRT is a very successful BRTS model from which a lot can be learnt for Pune .[11]

**LESSONS FROM VIVA:**
The main lesson learnt from VIVA is the utilization of the outer lane instead of the inner one; this eliminates the use of Foot Over Bridges and also in a signal stop, when the BRT bus is taking a turn in Pune; it halts all the main traffic as it occupies the inner lane and has to traverse all other lanes to take a turn; this unwontedly adds to the already chaotic traffic situation.

Another good point is the Public Private partnership; this idea will introduce competition into the picture and thus many corporate entities will vie for the BRT Ownership providing better services than the other and only adding to the benefit of the customer who is the general public. The idea of the transfer ticket is also a very good one; for. E.g. If a passenger is taking the BRT till a certain length and then deviating from course taking an ordinary PMPML bus then She/he should be allowed to purchase an integrated ticket which is cheaper than the total of both the separate fares, thus encouraging people to use not only the BRT but also the ordinary buses.

**IMPLEMENTING BRTS IN POPULATED CITIES (DHAKA)**:
Though we analyzed the BRT in cities like Pune and Toronto, it is a big challenge to implement a system of this caliber in a heavily populated city like Dhaka; Dhaka is the most populated city in the World with a population of over 12 Million, and also being a seamless blend of a traditional city and a fast emerging High-Tech Mega polis; it is a huge challenge to bring in a BRTS system, but it would be very beneficial to implement such a system considering the eyebrow raising traffic congestions and pollution graphs which seem to be climbing; In such a city, winning the confidence of the people will be the biggest goal for the BRT system as once people start trusting the system for the daily commute, they tend to switch from their cars and motorcycles and taxis/rickshaws to the new system (A good example is Kolkata Metro.) Efficient land use for the system will stand as a huge challenge in the way of implementing this system in Dhaka, but if done in a clever manner will prove as the single most important factor in decongesting Dhaka’s roads. Also connecting Dhaka’s immediate neighboring districts which are fast developing should be on the agenda for the BRTS Planners.

All these factors if brought together on a balanced scale will go towards making Dhaka a truly international city and providing Bangladesh with a platform for showcasing itself on a wider global Stage.

**CONCLUSION:**

The concept of BRTS is a young concept but has been accepted worldwide with open arms; the system has been instrumental in bringing up rapidly developing cities and contributing to the sustainability of their ever growing populations. This system though successfully implemented in many developed countries majority in the 21st. century, has to yet find its feet in many developing countries;

This concept has incorporated the use of latest technology from Efficient land use policy to High-Tech Hybrid buses to GPS navigation and tracking and smart card ticketing; and has opened the avenues for more innovation in the field of mass transportation in many countries;

Many big and old cities are finding it more sensible to have such a system which takes only a fraction of time and resources as compared to a subway/metro system but still has all the benefits.

In the 21st century, urban transport has taken the much needed deviation from a plain point to point transit system to a more modern and effective system which would accept all challenges thrown on it with a smile and something the city administration and more importantly its people could be proud of.

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