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INTEGRATON OF BRTS AND GSRTC BUS SERVICE: A CASE STUDY OF AHMEDABAD

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Abstract — Urbanization is a dominant process in the growth of nation's economy, Ahmedabad is well connected by various transportation system for intercity & interstate transport (Railway, Road, & Air Transport). Capital of Gujarat Gandhinagar is neighbour city of Ahmedabad city. Ahmedabad has emerged as an important economic and industrial hub in India. Ahmedabad city is the 6th largest city and the 7th largest metropolitan city of India & spread over 464.16 km2 of area. Ahmedabad's increasing population has resulted in an increase in the transportation demand and transportation activity. This has a direct effect on the level of transport demand, travel patterns and its impact on the environment. This rapid growth in automobiles has resulted in congestion, and air pollution. The Main bus station of GSRTC is placed in Geetamandir area which is CBD area, because of the buses there are so much congestion in surrounding area of bus station. The buses are passes from main commercial and CBD area like Kalupur, Shivranjani, Income tax, R.T.O, Nehrunagar, Paldi, Jashoda & Narol Cross road. At these main commercial & CBD area so much traffic congestion and traffic problem is common occurrence. The focus of the study is to integrate the BRTS & GSRTC transportation agency with terminal stations in Ahmedabad at different strategic location. To built the terminal outside of the city and connect it with BRTS corridor. In this study present GSRTC bus route is analyzed. Passenger willingness survey is taken.

Keywords-Integration, Interstate transport, GSRTC, BRTS

I. INTRODUCTION

Planning of transportation is the process of defining future policies, goals, investments and designs to prepare for future needs to move people and goods to destinations. There are main two transport agency which are providing their services into Ahmedabad city. Bus Rapid Transit System (BRTS), maintained by the Ahmedabad Janmarg Limited (AJL) and Ahmedabad Municipal Transport Service (AMTS). Gujarat State Road Transport Corporation (GSRTC) buses are also plying on roads of Ahmedabad city. Due to increasing population there is increase in the demand of public transport service. So, there is increasing fleet number. The Main bus station of GSRTC is placed in Geetamandir area which is CBD area. Because of the large number of trips of buses there is congestion on roads surrounding area of bus station. Integration is the one of the solution to reduce this effect. There is a variety of measures and practices to increase the integration within and amongst public transport systems. While benefits of integration can be significant, they cannot always be quantified. Quantifiable benefits like ridership growth, improved performance, reduced passenger wait times between transfers, lower operating costs, or an improved vehicle spare ratio are only part of the picture. Qualitative benefits include a superior experience for passengers, residents' improved access to regional locations, better customer information, better interagency relationships, and increased public support for transit.

II. AIM AND OBJECTIVES

The aim of the study is to design the terminal stations at different strategic location and integrate GSRTC bus services with BRTS to achieve the following objectives.

1. To reduce travel time of the GSRTC bus users.
2. To reduce the fuel cost of the GSRTC buses.

III. STUDY AREA

Ahmedabad city is located in the state of Gujarat, in the western part of India. Sardar Patel Ring Road is 76 km long ring road encircling the city of Ahmedabad. It meets the Ahmedabad-Vadodara Expressway at one point and crosses the Sabarmati River and the Mumbai-Delhi National Highway twice, Saurashtra, Kandla, Mundra, Himmatnagar, Mehsana and Gandhinagar.

GSRTC bus service is the main passenger state transport system of Gujarat. The daily 2471 bus trips originates or terminates in Ahmedabad city. In which 1627 trips has origin or destination point in Ahmedabad & 844 fleets through trips whose intermediate station is Ahmedabad. There are main 7 Entry/Exit point from where GSRTC buses enter/exit in Ahmedabad city.

1. Zundal is point from where Mehsana side buses enter/exit in Ahmedabad city.

2. Ranasan circle is point from where Himmatnagar, Rajsthan side buses enter/exit in Ahmedabad city.
3. C.T.M is point from where south side buses enter/exit in Ahmedabad city.
4. Hathijan circle (or Jashoda crossroad) is point from where south side buses enter/exit in Ahmedabad city.
5. Aslali checkpost (or Narol cross road) is point from where south side buses enter/exit in Ahmedabad city.
6. Santhal circle (or Ujala circle) is point from where Saurashtra side buses enter/exit in Ahmedabad city.
7. Shantipura circle (or Sanand crossroad) is point from where Kutch and Viramgam side buses enter/exit in Ahmedabad city.

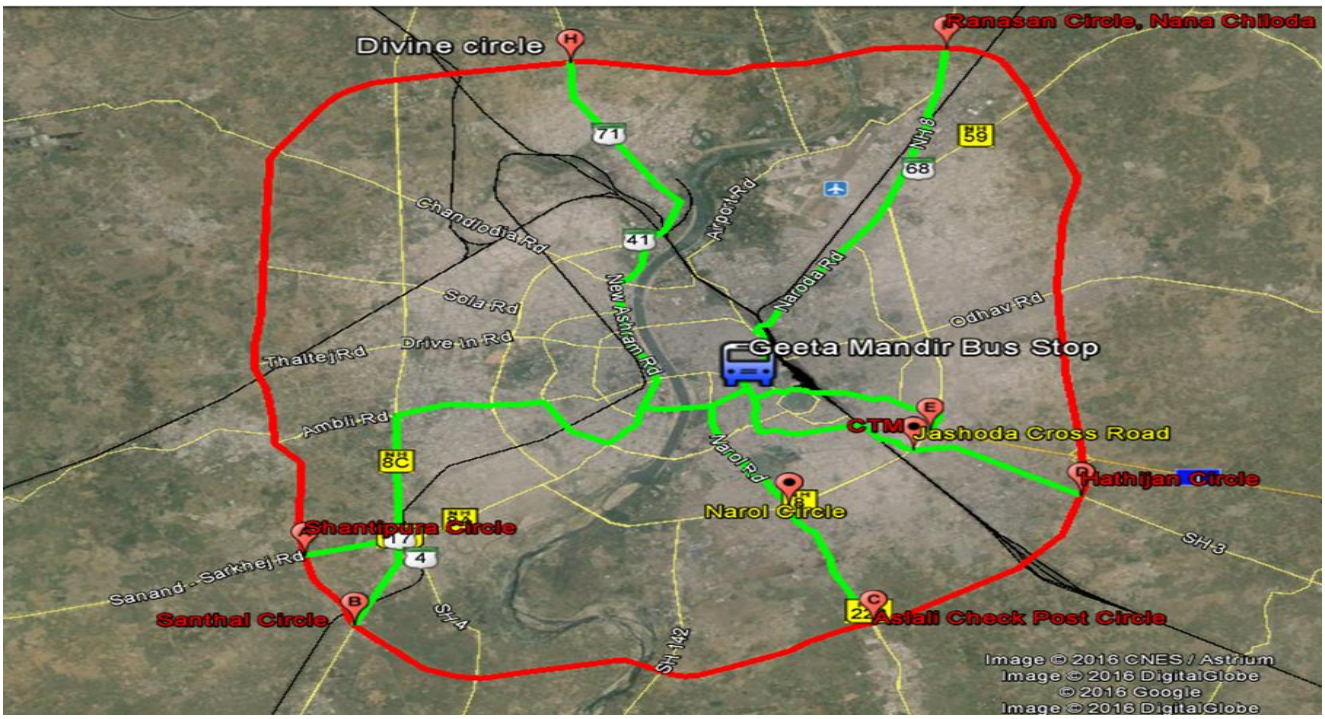

Figure 1 Existing all GSRTC route with 7 entry/exit point (Green colour)

In figure 1 green colour line indicate existing GSRTC route & red line indicate sardar patel ring road.

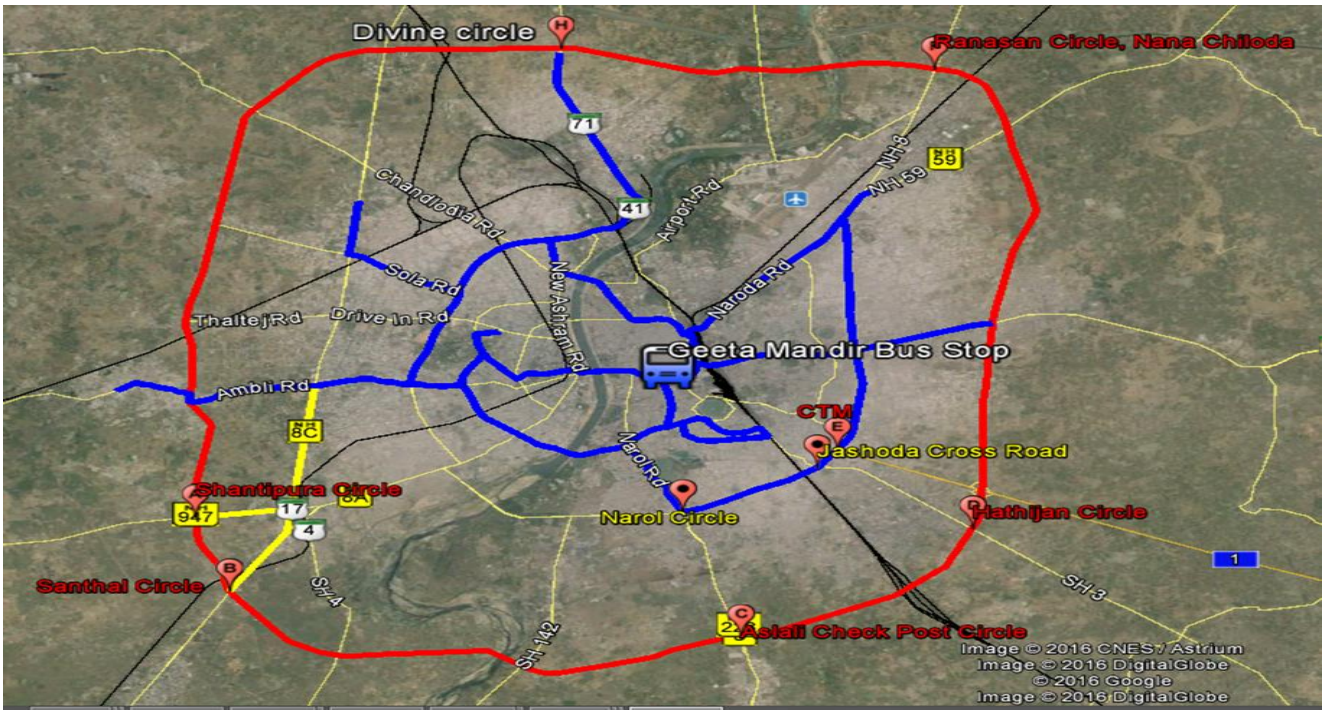

Figure 2 Figure 3 Existing BRTS Route (Blue colour)

In figure 2 blue colour line indicate existing BRTS route & red line indicate sardar patel ring road.

IV. LITERATURE REVIEW

Integration means the speedy, convenient and economical connection of services to make up complete journeys for passengers from origin to final destination. This should include integration of timetables, ticketing and any specialized facilities needed such as special services for the disabled or elderly. One of the big advantages of the private car is that if parking is available, it gives a door-to-door service. Public transport never match this but with the integration of services it is possible to get closer to it than would otherwise happen.

The objective of integrated public transport is clear - to achieve a high transit modal share with a seamless service using two or more modes. Measures for integrating transport services include the following five broad categories

Table 1 Types & description of Integration

Types of Integration	Description
Physical integration	The close proximity and ease of access at mode interchanges will greatly enhance public transport services. Walkways should be carefully designed for passengers to change mode. Passengers should be within a short walking distance from their residences to a transit stop". Cities like Hong Kong and Singapore have been able to build mass transit stops in the heart of neighbour hoods, thereby providing close proximity to residences, offices and retail outlets.
Network Integration	"Bus and rail systems should be an integrated network in their own right and these separate netwoks should further complement one another. Feeder services using buses, trams or light rail should be designed to maximise the patronage of the trunk routes. Network integration is closely linked to physical integration and both contribute towards the integration of infrastructure". For instance, it is relatively easy to change between different lines on the London Underground (tube) network as tube stations have been designed with a number of interchange points between tube lines. Cities such as Hong Kong, Singapore and Kuala Lumpur have been able to redesign bus routes so that they feed into, and support the mass transit/metro lines. Similarly, London's underground and buses connect with the above ground heavy rail network to take passengers to their final destinations. An essential part of network integration involves timetabling services so that intramodal and intermodal services connect efficiently and effectively.
Fare Integration	"A single fare card (smart card) for multiple transit services will facilitate the transfer between two modes. Refund (discount) can be implemented as an inducement for those who transfer from one mode to another mode, for example, Hong Kong, Singapore and London all

	have a smart card system in place which has underpinned the increase of public transport usage. For example, public transport in Hong Kong accounts for approximately 85 per cent of all main mode trips respectively. In London, journey stages by public transport modes (defined as bus, tram, Underground, DLR, rail, taxis and private hire vehicles) increased in share from 30 per cent in 1993 to 34 per cent by 2000, and to 41 per cent by 2008 and 2009. The 7 per cent increase in the share of public transport usage between 2000 and 2009 is equivalent to a 5 per cent increase in trip based mode share for public transport in London. While other factors have driven patronage growth in these examples, fare integration has underpinned and supported integration in the networks.
Information Integration	"A comprehensive, easy to- use passenger travel guide is critical to successful multi-modal travel. The signage at rail and bus stations should be properly designed to convey effective information to travellers. Information Technologies (IT) and Intelligent Transport Systems (ITS) can play important roles in integrated transport in general and information integration in general"; for example, at the major railway stations in Japan, they have very clear signs differentiating directions to the high speed rail network, the intercity trains network and the suburban/local trains network. In addition, websites provide public transport users with information on the multi-modal transport options available and the related details.
Institutional Integration	"A common institutional framework is better able to undertake land use planning, travel demand management and integrated public transport services. In the absence of such common framework, cooperation and coordination amongst government agencies, and between the private and public sectors, become vitally important"; the evidence suggests that fewer layers of government are conducive to providing integrated multi-modal transport, e.g. the city states of Hong Kong and Singapore

V. DATA COLLECTION & ANALYSIS

Data collection is the process of gathering the required information for each selected unit in the study. Data collected includes route length from selected origin to destinations. The data analyzed within this paper were collected using a bus-schedule of GSRTC bus, driver & passenger questionnaire survey. In this study a driver & passenger questionnaire survey is to collect existing route & how much time is taken to clear Ahmedabad city traffic. From that survey maximum and minimum time is found to clear Ahmedabad city traffic.

The attempt has been made to evaluate the cost and benefits in terms of fuel consumption, travel time saving by constructing a terminal on S.P.Ringroad .This has been done based on the bus schedule, route length & passenger who is not terminate their journey in Ahmedabad city.

From analysis of bus schedule departing from Ahmedabad bus station and intermediate station is Ahmedabad and its trip number is as shown below.

Table 2 Bus route type & trip number

Bus route type	Total trip number
Departing from Ahmedabad bus station	1627
Intermediate station is Ahmedabad	844

From driver and passenger survey route length and average minimum and maximum time is also derived and average minimum and maximum travel speed is derived which is shown below table-3.

Table 3 Bus route and operation characteristics

Start Point	End Point	Route length km	Route travel time(minute)		Travel speed/kmph	
			Max.	Min.	Max.	Min.
Geetamandir	Zundal	19.00	80	45	14.25	33.75
Geetamandir	Shantipura circle	19.30	90	40	12.86	28.95
Geetamandir	Sanathal circle	20.40	90	40	13.59	30.60
Geetamandir	C.T.M	7.80	75	15	6.24	31.20
Geetamandir	Aslali check post	17.60	75	35	14.08	30.16
Geetamandir	Ranasan circle	17.30	90	40	11.53	25.95
Geetamandir	Hathijan circle	14.80	75	35	11.83	25.36

By survey at GSRTC terminal average passenger in each trip is found which is distributed in table according to entry and exit point. From bus schedule total trip are classified according to entry and exit point which is shown below.

Table 4 Bus fleet details by route

Entry/Exit Point	Entry/Exit Point	Total trip	Average Passenger in each trip
Adalaj/Zundal Circle	C.T.M & Jashoda or Narol	312	27
Adalaj/Zundal Circle	Ranasan Circle	4	15
Adalaj/Zundal Circle	Santhal & Shantipura Circle	104	25
C.T.M, Jashoda & Narol	Ranasan Circle	94	20
C.T.M, Jashoda & Narol	Santhal & Shantipura Circle	244	23
Ranasan Circle	Santhal & Shantipura Circle	86	18

By comparing route length of route via Geetamandir and route via S.P.Ringroad, we found matrix of differences in route length which is shown below. The route length via Geetamandir subtracted by route length via S.P.Ringroad. Difference matrix is shown in table-5.Minus sign is indicate that via Geetamandir route is better.

Table 5 Difference matrix of route length (via geetamandir-via S.P.Ringroad)

	Zundal	Shantipura circle	Sanathal circle	C.T.M	Aslali check post	Ranasan circle	Hathijan circle
Zundal	0	16.30	14.40	0.80	-2.60	26.10	1.50
Shantipura circle	16.30	0	36.70	-0.50	14.50	2.50	4.90
Sanathal circle	14.40	36.70	0	3.60	18.60	0.90	8.80
C.T.M	0.80	-0.50	3.60	0	10.20	6.40	12.10
Aaslali check post	-2.60	14.50	18.60	10.20	0	3.70	1.10
Ranasan circle	26.10	2.50	0.90	6.40	3.70	0	8.70
Hathijan circle	1.50	4.90	8.80	12.10	1.10	8.70	0

By multiplying appropriate route length with total number of trip savings in kilometer per day is derived and this savings in kilometer per day is divided by average kilometer travel by bus per litre. Here average fuel consumption is taken 5.1 kilometer per liter diesel. Fuel savings in 1 day is shown below.

Table 6 Total Fuel savings in 1 day1 day & 1 year (in rupees)

Entry/Exit Point	Entry/Exit Point	Reduction in trip length via S.P.Ringroad	Total Fleet per day	Savings in km per day	Savings of fuel in litres per day
Adalaj/Zundal Circle	C.T.M & Jashoda or Narol	5.4	312	1684.8	330.35
Adalaj/Zundal Circle	Ranasan Circle	26.1	4	104.4	20.47
Adalaj/Zundal Circle	Santhal & Shantipura Circle	15.3	104	1591.2	312
C.T.M, Jashoda & Narol	Ranasan Circle	6.26	94	588.44	115.38
C.T.M, Jashoda & Narol	Santhal & Shantipura Circle	8.31	244	2027.64	397.58
Ranasan Circle	Santhal & Shantipura Circle	1.7	86	146.2	28.67

By multiplying savings of fuel in litres per day with fuel price. Fuel price is taken ₹ 51 per litre. Savings in ₹ per day and savings in ₹ per year shown below.

Table 7 Fuel saving in rupees

Entry/Exit Point	Entry/Exit Point	Saving in ₹ per day	Savings in ₹ per year
Adalaj/Zundal Circle	C.T.M & Jashoda or Narol	16847.85	₹ 6149465.25
Adalaj/Zundal Circle	Ranasan Circle	1043.97	₹ 381049.05
Adalaj/Zundal Circle	Santhal & Shantipura Circle	15912	₹ 5807880.00
C.T.M, Jashoda & Narol	Ranasan Circle	5884.38	₹ 2147798.70
C.T.M, Jashoda & Narol	Santhal & Shantipura Circle	20276.58	₹ 7400951.70
Ranasan Circle	Santhal & Shantipura Circle	1462.17	₹ 533692.05
Total Saving		**335299.99**	**₹ 22420836.75**

By comparing travel time of route via Geetamandir and route via S.P.Ringroad, we found matrix of differences in travel time which is shown below. The travel time via Geetamandir subtracted by travel time via S.P.Ringroad. Difference matrix is shown in table-8.Minus sign is indicate that via Geetamandir route is better.

Table 8 Difference matrix of travel time (in minute) (via geetamandir-via S.P.Ringroad)

	Zundal	Shantipura circle	Sanathal circle	C.T.M	Aslali check post	Ranasan circle	Hathijan circle
Zundal	0	65	65	60	45	80	65
Shantipura circle	65	0	90	60	65	75	55
Sanathal circle	65	90	0	55	70	70	60
C.T.M	60	60	55	0	45	65	50
Aaslali check post	45	65	70	45	0	85	75
Ranasan circle	80	75	70	65	85	0	75
Hathijan circle	65	55	60	50	75	75	0

By multiplying appropriate travel time saving with Average Passenger in each trip gives savings in travel time per day is derived and this savings in travel time per day which is shown below in table-9.

Table 9 ***Travel time savings in 1 day & 1 year***

Entry/Exit Point	Entry/Exit Point	Reduction in trip length via S.P.Ringroad	Average Passenger in each trip	Savings in minute per day	Savings of travel time in hours per day	Savings of hour per year
Adalaj/Zundal Circle	C.T.M & Jashoda or Narol	50	27	1350	22.50	8212.50
Adalaj/Zundal Circle	Ranasan Circle	90	15	1350	22.50	8212.50
Adalaj/Zundal Circle	Santhal & Shantipura Circle	75	25	1875	31.25	11406.25
C.T.M, Jashoda & Narol	Ranasan Circle	80	20	1600	26.67	9733.33
C.T.M, Jashoda & Narol	Santhal & Shantipura Circle	60	23	1380	23.00	8395.00
Ranasan Circle	Santhal & Shantipura Circle	70	18	1260	21.00	7665.00
Total Savings					**146.92**	**53624.58**

VI. CONCLUSIONS

Following are the important observations from the surveys, study and analysis.

1. If terminal is built at strategic location of S.P.Ringroad & intermediate buses are restricted than there is savings of ₹ 22420836.75 per year.
2. Similarly, if the terminal is design as per above condition it is found that the total 53624.58 hours passenger travel time will be saved.
3. Due to above facilities it is also possible to reduce the maintenance cost of buses as they have to cross the inner roads of city, which creates big hurdle in the smooth movements of buses.

VII. REFERENCES

1. Barry J. Simpson, Urban Public transport today
2. Guidelines for preparation of integrated transport plans (May 2012), Western Australian Planning Commission
3. John Preston, INTEGRATION FOR SEAMLESS TRANSPORT, International Transport Forum Discussion Paper 2012-01
4. John Preston, Moving Forwards: Improving Strategic Transport Planning in Wales
5. National Urban Transport Policy, 2014, Ministry of Urban Development, Government of India
6. Patrik Tornberg, Making Sense of Integrated Planning , Challenges to Urban and Transport Planning Processes in Sweden
7. TCRP REPORT 173, VOLUME I, Improving Transit Integration Among Multiple Providers,Volume I Transit Integration Manual
8. TCRP REPORT 173, VOLUME I, Improving Transit Integration Among Multiple Providers, Volume II Transit Integration Manual

9. Tejas Rawal, Dr. V. Devadas, Nand Kumar (March 2014) INTEGRATED MULTI-MODAL TRANSPORTATION IN INDIA

10. Thematic Research Summary: Passenger Transport https://www.kowi.de/en/Portaldata/2/Resources/fp/trip-passenger-transport.pdf

11. Transit Capacity and Quality of Service Manual, 3rd Edition (CHAPTER 10 STATION CAPACITY)