BRT STUDIES IN BRAZIL
Technical Report

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**MESSAGE FROM THE CHAIRMAN OF THE EXECUTIVE BOARD OF NTU**

Fortunately the theme of urban mobility has gained noble space in discussions at all levels. For the National Association of Urban Transportation, NTU, this topic has always been addressed as the main item of a positive agenda, studies related to BRT systems, the Bus Rapid Transit - a technology developed in Brazil and now used in over 80 cities worldwide.

NTU support to BRTs is justified because it is a mass transport alternative suitable to cities of all sizes, notably for its low cost and shorter implementation time compared to other modes. It is a system where the buses circulate on a network of exclusive lanes with special attributes, such as multiple positions of stops at stations, possibility of overtaking, level boarding, universal accessibility, articulated vehicle, payment and control outside the bus, good spaces at stations and information system for users.

Its benefits are reflected in the fluidity and speed of displacement, and therefore the quality of life of the user, who now has a transport mode that is more comfortable, efficient and also safer from an environmental standpoint.

The technical report "BRT Studies in Brazil" demonstrates how this system is viable and can therefore be easily integrated with what already exists in terms of urban mass transportation. This sum will result in permanent solutions to ensure the sustainability of essential public services to Brazilians.

This publication constitutes a new chapter of NTU's technical studies in these 25 years of existence in which it has been establishing itself as a national benchmark for sustainable development of urban mass transportation.
FOREWORD

Soon after the release of the first edition of this technical dossier, the 2,200 copies produced were sold out due to high demand from various sectors of Brazilian society. Many affiliates have requested copies for distribution to state and local governing bodies. In addition, we received numerous requests from higher education and research institutions, which showed interest in exposing NTU material to the academics and scholars in the field. We also received requests from companies operating in the sector of urban public transport of passengers. Thus, by the end of 2011, only a technical reserve was preserved in NTU’s collection.

Due to the first edition’s success, NTU is now launching this revised edition. Besides small graphical changes, this edition includes a detailing of the BRT systems of Recife, state of Pernambuco, which was not included because the projects had not been approved before publication of the first edition. Finally, we made some modifications to the case of Porto Alegre, state of Rio Grande do Sul, and Salvador, state of Bahia, to better reflect the characteristics of the projects.

We hope this issue will once again contribute to consolidate the implementation of concepts about BRT and consequently the prioritization of urban public transport, through the 13 case studies in Brazilian cities.

Otavio Vieira da Cunha Filho
NTU CEO
Following the publication of the 1st and 2nd editions of this technical report, we have received various international requests for the document in English language. In addition to showing the outreach of NTU’s work, these requests also indicate that there is a demand for technical knowledge to be used by public agencies, universities, researchers and other overseas organizations, which are dedicated to the theme.

Hence, NTU, once more, contributes to broad dissemination of successful experiences undergoing in Brazil. We hope that the catalogued projects will be replicated worldwide and BRT advantages will be further understood as one of the main technological options that are suitable to public transport prioritization and for improving the quality of life in cities.
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Urban passenger transportation on wheels is in a process of modernization to meet the needs of the population in an increasingly efficient way. This process has been occurring through the gradual transformation of relations between business sector, governing bodies and society, who began to work together for the establishment of infrastructure and services consistent with the social and economic advances achieved in the last two decades. In the current context, users expect and demand low cost service, high reliability, and security that ensure the daily participation in the various activities spread throughout the urban space. To meet these increasingly complex demands, the modernization and transformation of public transportation systems are directly associated with the use and improvement of knowledge and experience accumulated by the sector.

The implementation of BRT (Bus Rapid Transit) systems in Brazilian cities is undoubtedly one of the most important steps for the urban passenger transportation to be really efficient and in line with the expectations of the population. Originally designed, tested, operated and approved in Curitiba, Brazil, BRT systems have
become international benchmarks of high performance, quality and low cost mass transportation. Today, major cities in the world use the BRT concept as the main mode of mass transport as the backbone for sustainable urban development policies. According to ITDP (2008), a BRT system costs 4 to 20 times less than light rail vehicles systems and between 10 to 100 times less than a subway system. Thus, we have the opportunity to increasingly explore and advance in the operation of BRT systems, which may influence the urban mobility of much of the Brazilian population.

Accordingly, NTU has been developing a series of initiatives aiming to help government and business sectors, and society to have access to information about the latest developments related to the implementation of BRT systems. In 2010, NTU has released a technical report describing the concepts and elements of BRT systems costs (NTU, 2010). The document detailed how BRT systems can be built from the rationalization and consolidation of transportation services by bus. It sought to provide our members and the wider community with detailed information for the consolidation of technical and institutional bases of BRT systems in Brazil.

Once more aiming to contribute to progresses in this area, this technical report is intended to disclose various initiatives to implement BRT systems in Brazil. This publication aims to catalog the various characteristics of BRT systems that are being designed and built in major Brazilian cities. Furthermore, we seek to discuss how the BRT concept has been adopted in order to examine best practice references and point out areas for improvements and refinements.

Through the contact with the main individuals involved in the design, project, management and implementation, it was possible to diagnose the current stage of development of BRT systems in 13 Brazilian cities. In particular, we seek to describe the context and challenges, the basic design of BRT corridors, the physical-operational characteristics, the environmental aspects, the physical design and the relationship with urban planning activities. The following sections of this document describe the projects of BRT corridors in major Brazilian cities. Subsequently, the analysis of the current situation and the conclusions are presented.
Belo Horizonte is the sixth most populous city of Brazil. It has more than 2.3 million inhabitants. The city occupies approximately 331 km² and has become the main hub of industrial and commercial development of the state of Minas Gerais. (IBGE, 2010; PBH, 2011). The service sector accounts for 83.12% of the economic activity, while the industrial sector represents 16.88% of the total.

The city of Belo Horizonte faces traffic problems arising from the growing number of vehicles in use and population increase. According to data from the National Traffic Department (DENATRAN, 2011), there are more than 1.3 million vehicles in circulation. In recent years, the average annual fleet growth has been at around 5%. In addition to this vehicle fleet growth, the city faces the challenge of hosting matches of the Confederations Cup in 2013 and the World Cup in 2014, which will be held in the Mineirão stadium.

The Public Mass Transportation Network of Belo Horizonte includes the mass transportation system by bus, managed by BHTrans, and the metro line, managed by the Brazilian Urban Train Company. There are 5 bus-subway integration stations established along the itinerary of the subway, which enable physical and fare integration between the two modes. This system is responsible for 3.8 million trips made on a daily basis (BHTRANS, 2011).
The concession contract for Belo Horizonte's mass transportation system was auctioned in 2008 for a period of twenty years and can be renewed. As of the entry into force of the new contract, the line system was structured in four networks, each operated by a consortium of mass transportation companies. The networks were defined according to the spatial overlap of lines in the neighborhoods and access to major transportation corridors in the city, seeking the future viability of the organization of the network of lines of these BRT corridors. There are 2,8 thousand vehicles operating the services.

**BRT PROJECTS OVERVIEW**

BRT projects are part of the PlanMob-BH, which seeks to encourage a policy of urban occupation towards further intensification in the vicinity of mass transportation corridors. The BH-PlanMob will be gradually implemented over the next 9 years and aims to achieve a sustainable modal division, i.e., decrease circulation of private cars and increase travel by non-motorized modes.

The BH-PlanMob comprises several BRT corridors, which will be implemented in the coming years. In this technical dossier we present the current status of 4 corridors. These corridors are aimed at improving the mobility of populations in both north and northeast regions of the city efficiently and also connect the city's downtown to the stadium Mineirao.

Investments in each corridor are as follows:

- **Antonio Carlos**: will comprise investments exceeding R$ 588 million. The funds that will be granted by the World Cup PAC (Growth Acceleration Program) amount to R$382 million, and the municipal government will collaborate with R$206 million. For the basic design, municipal funds amount to R$ 5.9 million; for expropriations R$ 206 million will be allocate; for construction works (initiated in February 2011) funds will be fomented by municipal and state governments. The expected completion of construction works is August 2013;
• Carlos Luz-Pedro II: investments of R$ 233.5 million will be granted. Most of these funds will come from the federal government, of which R$146 million will come from the World Cup PAC and R$87.5 million from the municipal government (R$ 87.5 million). It is estimated that R$3.5 million of municipal resources are being spent on basic construction projects and $ 87.5 million are earmarked for expropriations. The construction works are scheduled to start in September 2011, with funds of around R$146 million from state and municipal governments. The expected completion of construction works is December 2013;

• Cristiano Machado: approximately R$53 million will be invested. It will include R$50 million from the World Cup PAC, R$2.6 million will be invested by the municipal government. For the basic design, funds will amount to R$1.2 million, from the municipal government. No expropriations will be necessary. The works are scheduled to start in August 2011 and will be completed in August 2012, with municipal investment amounting to R$ 146 million;

• Central Area: will total R$ 58 million in investments. World Cup PAC funds will amount to around R$50 million. In return, the municipal government will invest R$ 8 million. For the basic design, funds will amount to R$1 million, from the municipal government. No expropriations will be necessary. For the construction works, which will start in October 2011, R$ 55 million will be invested with municipal funds. The expected completion is February 2012.
GENERAL CHARACTERISTICS OF BRT CORRIDORS

The Antônio Carlos Corridor, which will be 14.9 km long, will connect the hotel region of Belo Horizonte to the Mineirão / Mineirinho complex. The total investment in the construction of terminals will be R$60 million. The civil construction works will cost R$528 million. The basic project of this corridor is completed, and the executive project is scheduled to be completed in June 2011. The construction works have been auctioned and assigned. The expected completion of the operational project is September 2011.

The Carlos Luz-Pedro II corridor will be 13km long and will require investments to build terminals, which will total R$40 million. The investment in civil construction works will amount to approximately 193.5 million. The basic project is completed, and the executive project is scheduled to end in July 2011. So far the operational project has not been elaborated. The bidding notice for construction works will be finalize by July 2011, and the contracting for these works is scheduled for September 2011.

The Cristiano Machado Corridor will provide indirect access to Mineirao Stadium during the 2014 World Cup. With 6 km of extension, it will connect the city’s downtown center to the northeastern region, integrating to the subway. The basic and executive projects have already been completed. With the bidding notice drawn up, the construction works auctioned will be signed in August 2011.

The BRT Central Area has investments in construction works of around R$55 million. The basic project are completed and the executive project is scheduled for October 2011. The bidding notice of the construction works has not yet been prepared, but the expectation for signing construction work contracts and finishing the operational project is October 2011.

In all of these corridors, the operators will be responsible for investing in the implementation of control and e-ticketing equipment, as well as the acquisition of the fleet with specifications suited to the corridors.

BRT CORRIDORS’ PHYSICAL DESIGN

Mainly due to the high flow of vehicles, the four corridors will use rigid pavement (concrete). Each corridor will have different configurations in terms of location and spacing of the stations and integration terminals, which are arranged according to the conditions of each case.

In Carlos Antonio Corridor 3 integration terminals will be built, 2 of which already exist and will be adapted to the operation of the BRT, and 1 will be built through concession. 26 stations transfer stations will be built with a distance of 500 meters between them. Overtaking lanes in the corridor are anticipated in transfer stations.
Along the 13 km of Carlos Luz-Pedro III corridor 1 integration terminal and 17 stations will be built, with an average distance of 500 meters between them. The corridor will operate with areas for overtaking in all sections between BRT stations so as to avoid the formation of queues.

With an integration terminal, Cristiano Machado Corridor will have 10 stations, where the distance between them will be 440 meters. To avoid queuing, there will be overtaking lanes along the corridor.

In the Central Area’s Corridor there’s no expectation of construction of integration terminals. There will be 6 stations with a distance of 200 meters between them. There will overtaking lanes in all stretches between stations.

In the corridors, integration with non-motorized modes will occur with the implementation of bike paths along the corridor and the construction of bicycle integration terminals, except in the Central Area Corridor. Only in Carlos Luz Pedro-II and Cristiano Machado corridors are not planned sidewalks treatment along the corridor, which will facilitate access to stations and terminals.
BRT station in the central area
BRT Station Landscaping
BRT CORRIDORS OPERATION

The corridors will be positioned along the median strip and will be for the exclusive use of bus vehicles. In them will operate express, semi-express and stopping lines.

<table>
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<tr>
<th>Corridor</th>
<th>Fleet (vehicles)</th>
<th>Peak hours demand (passengers)</th>
<th>Daily demand (passengers)</th>
<th>Peak hours frequency (Vehicles/h)</th>
<th>Frequency between peaks (Vehicles/h)</th>
</tr>
</thead>
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<tr>
<td>Carlos Luz - Pedro II</td>
<td>180 conventional 32 standard 35 articulated</td>
<td>12 thousand</td>
<td>180 thousand</td>
<td>110</td>
<td>70</td>
</tr>
<tr>
<td>Antônio Carlos</td>
<td>210 conventional 166 standard 98 articulated</td>
<td>31 thousand</td>
<td>350 thousand</td>
<td>244</td>
<td>121</td>
</tr>
<tr>
<td>Central Area</td>
<td>644 conventional 340 standard 35 articulated</td>
<td>19.9 thousand</td>
<td>135 thousand</td>
<td>143</td>
<td>66</td>
</tr>
<tr>
<td>Cristiano Machado</td>
<td>274 conventional 142 standard 77 articulated</td>
<td>23 thousand</td>
<td>250 thousand</td>
<td>212</td>
<td>130</td>
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</tbody>
</table>
The current speed of the buses operating in the implementation of Carlos Luz-Pedro II corridor is 15.5 km/h, and the expected average speed in the corridor is 25 km/h. On Antônio Carlos Corridor estimated speed of the project is 25 km/h, enabling an increase of 11 km/h in relation to the current situation. The Antônio Carlos Corridor has been restructured since 2004 and already has a stretch operating with exclusive lanes. Current speed was considered for the critical stretch, which has not yet undergone interventions. The Central Area Corridor will operate with the operating speed of 22 km/h. Currently, the buses operate at 8 km/h. As to the Machado Corridor, currently the speed is 23 km/h, but future operation expected is 30 km/h.

Besides the increase of operating speed on Carlos Luz-Pedro II Corridor, an increase of service level to passengers is planned, going from the current 7 to 5 passengers/m².

The fare will be charged in the corridors before boarding in closed stations, which will reduce the waiting time of vehicles at stations, by speeding up the boarding of passengers. However, the intersection control in corridors not yet been designed.

The Control and Monitoring Center will be responsible for the control of travel timetables at the terminals, overseeing the operation of the lines, among other operational inspection activities. For users, electronic information services are offered with data about arrival and departure of vehicles, travel destinations, among others.

The consortium of bus companies is responsible for the operation of the corridors.

BRT SYSTEM BUSINESS PLAN

The form of remunerating operators will be the fares, which will not be subsidized. The whole charging will be controlled by private enterprise. A Compensation Chamber will not be implemented in the corridors, since the operation contract meets the conditions laid down when the service bid was awarded. The use of information boards at stations is foreseen and no parking lots will be built for cars integrated to the corridors.

INTERFACE WITH URBAN PLANNING

The corridors are planned as the main structuring axes proposed in the Metropolitan Transportation Master Plan. Neither a Preliminary Neighborhood Impact Assessment was performed nor a measurement of the extent of urban impact has been performed for any of them. There is no expectation of a joint urban operation in any of the corridors. In the Carlos Luz-Pedro II Corridor the remaining areas of expropriations receive urban treatment and landscaping. As to the Cristiano Machado corridor, changes will be made only in the median strip. In the other corridors, the physical space adjacent to the corridors will receive urban treatment, in order to reconcile the different soil uses along the corridor. The sidewalks will receive urban treatment with improved access along the corridor.

The corridors are important axes of access to the population residing in the Area of Special Social Interest, which ensure greater
social inclusion of the population residing in the suburbs, with the access road to the city’s downtown.

ENVIRONMENTAL ASPECTS

Environmental Impact Assessments have been prepared for all corridors. Moreover, the vehicles will operate with diesel and bio-diesel, as specified in Proconve Phase 7. With the optimization of the operation of the lines, reduction of travel time, reduced fuel consumption and expected migration of users from individual to the collective transportation, it is estimated that there will be a reduction in the emission of pollutants into the environment.
BRASILIA, FEDERAL DISTRICT

CONTEXT AND CHALLENGES

In the demographic census conducted by IBGE in 2010, the Federal District’s population reached 2,570,160 inhabitants. The region has the second largest GDP per capita of Brazil (R$ 40 thousand). Among many of the city’s peculiarities is the fact that its main economic activity is the administrative role and be registered by UNESCO as heritage of humanity (IBGE, 2010).

Brasilia, in spite of being a new capital when compared to the others, faces the same traffic problems of big cities. The number of cars in circulation grows every year and, coupled with a public transportation system that does not adequately meet the demand, what we see are roads at full capacity.

There is a local consensus that improvements in the city’s transport system are needed on a short-term horizon, especially with regard to the public transportation system. This measure is even more evident with the hosting of the World Cup matches in 2014.

DFTrans (the city’s traffic department) manages the Collective Transport System, which is classified as Basic and Supplementary. The Basic Service includes subway and road modes that can operate through physical, fare and operational integration. The Supplementary Service is made up of bus lines with different features from the Basic Service to meet specific segments of users.
Due to the concentration of jobs in the Pilot Plan of Brasilia, lack of renewal of passengers along the routes and travels at peak times are characteristics of public transport in the Federal District. About 60% of all trips are concentrated in peak hours, for an average distance of 49km from the Pilot Plan. The renewal rate of passengers is 1.74. (GDF, 2010)

BRT PROJECTS OVERVIEW

The purpose of the construction of the BRT is to design axes that are integrated into the existing mass transportation network. In a first stage, the South Axis Corridor will serve approximately 600 thousand people, who will travel between the satellite cities of Gama and Santa Maria, and the Pilot Plan. In the implementation of the BRT system an investment R$ 760 million is estimated. Federal funds account for most of the investment with a complement from the local government.
BRT Corridor Longitudinal section
GENERAL CHARACTERISTICS OF BRT CORRIDORS

With a length of 43.7 km, the South Axis Corridor will be an important connection between the administrative regions of Santa Maria and Gama and the Pilot Plan. This corridor will also serve the population residing in the Southern Surrounding Cities of the Federal District (cities in the state of Goiás which perform most of their activities in Brasilia.

The basic design of the South Axis corridor was completed, and the executive project is in preparation. The public bidding notice is being prepared for signing construction work contracts. The operational project has not yet been designed.

BRT CORRIDORS’ PHYSICAL DESIGN

The corridor will have mixed pavement (asphalt and concrete), in order to support more intense bus traffic. 5 integration terminals and 24 stations will be built along the corridors with an average distance of 1,000 meters between them. Overtaking lanes are envisaged in all stretches between BRT stations. No bike parking racks have been envisaged in the integration terminals, nor the treatment of sidewalks along the corridor.
BRT station inside area
BRT CORRIDORS OPERATION

The corridor will be positioned near the median strip and will be for the exclusive use of bus vehicles. In it will operate semi-express lines. The charging of fares will take before passengers board onto the vehicle. Articulated vehicles with capacity for 160 passengers circulate in the corridor. The new system will have extensions in Gama (8.7 km long) and in Santa Maria (5.3 km long). The stretch will become individual starting at an intersecting point with road BR-040. It's estimated that the demand during peak hours will be 20 thousand passengers. About 200 vehicles per hour will operate in the corridor. This frequency will drop to 100 vehicles per hour in between peak periods. The agency responsible for BRT corridors will be the Secretariat of Transports (ST/DF).

BRT SYSTEM BUSINESS PLAN

The private sector will be responsible for the operation of the South Axis Corridor and there will be an specific public tender for the operation of the new corridor. There will be a Chamber of Compensation of Revenue and Credit responsible for the remuneration of the operators.

Construction of automobile parking lots integrated to the corridors is not envisaged.

INTERFACE WITH URBAN PLANNING

The South Axis Corridor is planned as a structuring transport axis in the Master Plan of Transportation and Mobility of the Federal District (2010) and will not give access to any population residing in an Area of Special Social Interest.

ENVIRONMENTAL ASPECTS

The Environmental Impact Assessment has not been prepared to date.
CAMPO GRANDE, STATE OF MATO GROSSO DO SUL

CONTEXT AND CHALLENGES

Campo Grande is considered the most important hub of economic and social activity of the state of Mato Grosso do Sul, where most of the active labor is absorbed by the service industry, trade and commerce. According to IBGE (2010) the population of the city encompasses approximately 1 million inhabitants.

The Integrated Transport System (SIT) of Campo Grande allows passengers to leave the neighborhood of origin and go to another neighborhood, passing or not through the central area, paying only one fare. The system also features integration terminals or stations, which are places of transshipment at various points throughout the city. Each terminal is strategically located in relation to the lines that feed. Entrance to the terminals is only allowed upon payment of the fare.

Currently mass transportation is operated by five private companies under concession, totaling 166 lines and carrying a daily average of 225 thousand passengers, which corresponds to a daily distance traveled of 100 thousand kilometers (Agetran, 2011).
Main corridors
BRT PROJECTS OVERVIEW

About R$252 million will be invested in the implementation of BRT corridors in the city. The municipal government will have primary responsibility for the investments, which anticipates the deployment of 46.5 km of corridors, with completion of construction works in 2014.
GENERAL CHARACTERISTICS OF BRT CORRIDORS

To implement transport North, South and Southwest corridors in Campo Grande approximately R$ 188 million will be invested in civil works. For the implementation of control and e-ticketing equipment R$5.3 million will be invested. Moreover, the construction of terminals will consume R$10 million, while the acquisition of the fleet will require R$36 million. Also an investment of R$13 million is planed for the implementation of bike paths.

Of this total investment, the federal government will provide R$ 210.7 million and the private operator will be responsible for R$ 41.3 million. The project of the corridor is in the conceptual design stage and is part of the Transportation and Urban Mobility Master Plan of Campo Grande. The operational design of the corridors is completed, but the basic and executive projects have not developed yet, which does not allow public tenders and signing construction contracts. According to the existing project, no expropriations along the corridors will be required.

BRT CORRIDORS’ PHYSICAL DESIGN

The corridor project envisages the use of mixed pavement (asphalt and concrete). Along the corridor 13 integration terminals and 67 stations will be built, with an average distance of 450 meters between them. Integration with non-motorized modes will occur by the implementation of bike paths along the corridor and construction of bike parking racks at integration terminals. For the pedestrians, the sidewalks will be revitalized along the corridor, which will facilitate access to stations and terminals.
Platform-level boarding

Exclusive lane for public transport
BRT Station Landscaping
BRT station in the central area
BRT CORRIDORS OPERATION

The corridors will be positioned along the median strip and will be for the exclusive use of bus vehicles. In these corridors, stopping bus lines will operate with 75 articulated vehicles. The estimated demand during peak hours will be of 31 thousand passengers. The predicted daily demand is of approximately 264 thousand passengers. Corridors will operate with headways of 3 and 5 minutes, respectively, at and between peak hours.

The current speed of buses in operation is 17km/h, and the expected average speed in the corridor is 21km/h. The fare will be charged before boarding at closed stations. The Control and Monitoring Center will be responsible for the control of travel timetables at the terminals, overseeing the operation of the lines, among other operational inspection activities.

BRT SYSTEM BUSINESS PLAN

The private sector will be responsible for the operation and fare collection in the BRT corridor. The fare will not be subsidized. There will not be a Compensation Chamber nor there will be other business linked to the corridors.

INTERFACE WITH URBAN PLANNING

The corridors are planned as transport corridors in the Transportation Master Plan and Urban Mobility in Campo Grande (2009). No prior Neighborhood Impact Study has been carried out. The adjacent physical space will receive urban treatment such as revitalization of sidewalks, implementation of bike paths, and landscaping readjustment. The roads where the corridor will be implemented will undergo revitalization, as well as the central ring of the city. The implementation of the corridor will improve the accessibility of the city and will bring benefits such as comfort and safety for passengers.

One of the problems found in the implementation of the corridor is fund raising because the project is not part of the Growth Acceleration Program (PAC) of the federal government.

ENVIRONMENTAL ASPECTS

The Environmental Impact Assessment has not been prepared to date.
CASCABEL, STATE OF PARANÁ

CONTEXT AND CHALLENGES

Cascavel is the fifth most populous municipality in Paraná. It has 286 thousand inhabitants, according to IBGE (2010). It stands out as a university center with over 21 thousand higher education students in seven educational institutions. It is also a benchmark in medicine and services (PMC, 2011).

Public mass transportation of this municipality is managed and supervised by the Transport and Traffic Engineering Company (Cettrans). The fleet consists of 136 buses, which are divided into: 7 articulated buses, 8 minibuses; 23 middle-buses, and 98 conventional buses. Most of the fleet (118 vehicles) has adaptations for accessibility (elevator for wheelchairs). Two companies are responsible for operating the system, which consists of 52 lines, 3 transhipment terminals and over 1,000 bus stops (shelters). In 2010, about 25 million passengers used urban mass transportation system (CETTRANS, 2011).

Currently, all lines that come from neighborhoods have their final stops at transhipment terminals. The connection between the terminals is made through the axis line and the direct line, which is semi express. Through the West Terminal, East Terminal and South Terminal, it’s possible to travel by paying one single fare.
BRT PROJECTS OVERVIEW

With a length of 24.5 km the BRT projects will contribute to increase the efficiency of the operational concept of the infrastructure and services currently offered. Expected investments for the implementation of construction works amount to approximately R$14.6 million and R$21 million in the construction of terminals. Other investments amount to R$ 42.8 million. The Inter-American Development Bank (IDB) will invest R$78 million in the implementation of the project. The BRT corridor will be implemented in binaries, with transposition at different levels. Construction of bike paths and semaphoric modernization are foreseen in the project. The operational project and basic project have already been designed and expropriations are not required to implement the corridor.
BRT CORRIDORS’ PHYSICAL DESIGN

Along the corridor, 4 integration terminals and 48 stations will be built, with an average distance of 450 meters between them. With a view to integrate with non-motorized modes, bike paths will be built along the corridor as well as bike parking racks at the integration terminals. An invest in infrastructure improvements for pedestrians is expected along the corridor. The sidewalks along the corridor, will receive infrastructural treatment in order to facilitate access.
Alternative Alignment - BRT Corridor
BRT CORRIDORS OPERATION

The corridors will be positioned near the median strip, with operation to the left, and will be for the exclusive use of bus vehicles. In these corridors, stopping bus lines will operate with 29 articulated vehicles. The estimated demand during peak hours will be of 9 thousand passengers.

The predicted daily demand is of approximately 78 thousand passengers. Corridors will operate with headways of 5 and 13 minutes, respectively, at and between peak hours.

The current operating speed of the bus is 15km/h and on the BRT corridor, in exclusive lanes, the operating speed of the bus is expected to be 20km/h. The fare will be charged before boarding, which will reduce the waiting time of vehicles at stations.

The priority of circulation of buses at intersections on the corridor will be made through the implementation of intersection control. The Control and Monitoring Center will be responsible for controlling travel timetables at the terminals, overseeing the operation of the lines, among other operational inspection activities. The agency responsible for the BRT corridor will be Cettrans.

BRT SYSTEM BUSINESS PLAN

The private sector will be responsible for the operation in the BRT corridor. Currently the fare charged is R$2.40. The fare of the BRT system is not subsidized and the whole collection will be private.

INTERFACE WITH URBAN PLANNING

This corridor is one of the main structuring axes proposed in the Urban Development Master Plan (2008). No prior Neighborhood Impact Study has been carried out. Conditions of accessibility in the city will be improved, in full, after the implementation of the corridor.

The definition of funding sources was one of the problems found in the implementation of the corridor.

Among the social benefits arising from the implementation of the corridor are the following: passenger comfort, reduction in waiting times, reduction of travel time, and revitalization of roads and accesses.

ENVIRONMENTAL ASPECTS

The Environmental Impact Assessment has not been prepared to date.
CURITIBA, STATE OF PARANÁ

CONTEXT AND CHALLENGES

Curitiba is the eighth most populous city in Brazil and the largest in the south of the country, with a population of 1.7 million inhabitants. The Metropolitan Area of Curitiba is formed by 26 municipalities and has 3.1 million inhabitants (IBGE, 2010).

Curitiba’s mass transportation system began to be implemented in the early 70s, integrated to road system and land use, as one of the bases for the planning proposed by the Master Plan for Curitiba. The transport system consists of express, feeder, direct, inter-neighborhood and direct lines and is complemented by other types of services: conventional, center circulating, special education, inter hospitals, and tourism (Curitiba, 2002). Currently 2 million passengers per day use the Integrated Mass Transport System, which consists of 1980 buses, serving 395 lines. The system is responsible for the direct employment of 15 thousand people, including drivers, fare collectors, inspectors, mechanics and other professionals (IPPUC, 2011; URBS, 2011).
Transport network map
**BRT PROJECTS OVERVIEW**

In 2003, Curitiba’s government developed studies and projects for the implementation of a Metropolitan Transportation Axis, called Green Line. This corridor would be 22 km long. Due to financial conditions, the Green Line project was divided into three steps:

1st stage - South Green Line - completed in 2009;

2nd stage - divided into four lots;

3rd - South Green Line Extension, which completes the project linking Atuba district to Contorno Sul.

The first stage of the Green Line, South Green Line, was implemented between the Pinheirinho Terminal and the Center of town (through Marechal Floriano Avenue), with funds from the Urban Transportation Program of Curitiba – Stage II, which received funding from the Interamerican Development Bank (IDB), AFD (French Development Agency) and the federal government. Currently, with 17 months of operation, it carries 22 thousand passengers on a daily basis.

The South Green Line extension will be 3 km long between Pinheirinho and Contorno Sul with investments of approximately R$ 18.8 million, of which the federal government will finance R$ 18.5 million for construction works that are scheduled to begin in 2011 and end in December 2012. The bidding notice is scheduled for July 2011.

**GENERAL CHARACTERISTICS OF BRT CORRIDORS**

The design and contracting of the executive project of South Green Line BRT were a responsibility of the Municipal Secretariat of Public Works (SMOP) of Curitiba, which will oversee the works with a third party company. The management process is being carried out by the Program Management Unit (UGP), which also accounts for environmental management and supervision together with the Concremat/Veja consortium. As to the basic projects they are a responsibility of the Institute for Research and Urban Planning of Curitiba (IPPUC).
BRT corridors
BRT CORRIDORS’ PHYSICAL DESIGN

Besides the use of tube stations that allow the circulation of users between the two spaces, the project includes lateral sealing of stations with glazing film glasses can reduce the incidence of sunlight and increase thermal comfort. The stations have rainwater harvesting systems which will be used to clean the terminals. These stations allow feeder buses coming from neighborhoods to leave passengers at stations from the South Green Line, which may make an integration through the Pinheirinho-Carlos Gomes line.

There is an expectation of extending 25% of the gutter network’s length, from 72km to 90km, which will allow the displacement of the new buses to downtown. In the first stage eight transport stations were built: São Pedro, Xaxim, Santa Bernadethe, Fanny, Marechal, PUC, UFPR and Avenida das Torres, which receive feeder buses that cross the old BR road allowing the exchange of bus without paying another fare.

This corridor will have appropriate signage, indicating of railings surrounding the stations, lanes separated by strips, resting islands and semaphores to ensure safe and comfort passage to the pedestrian. Among the districts of Pinheirinho and Jardim Botânico, three trenches and two viaducts were built, one trinary and four binaries allowing the crossing in a straight line and in one way.

The base for paving of pathways was laid on finished asphalt concrete due to local soil special conditions. 900 access ramps will be installed at corners and crossings.
INTERFACE WITH URBAN PLANNING

Among the urban interventions is planned the creation of a garden-park in the region of the old Salgado Filho pocket, halfway between the campuses of UFPR (Federal University of Paraná) and PUC (Pontifical Catholic University) and the recovery of riparian forest 600m from Belém river. About five thousand saplings of 22 native ornamental and fruitful species, 800 thousand seedlings of flowers will be planted throughout the route.

ENVIRONMENTAL ASPECTS

The use of soy-based biofuel and without the addition of mineral oil (diesel) in six of the 14 buses in the fleet is one of the environmental innovations of this project. It is estimated that by the end of 2012 at least 10% of the fleet operating in the city will be circulating with this type of fuel. This allows a reduction of up to 50% compared to diesel pollutants.
GOIÂNIA, STATE OF GOIÁS

CONTEXT AND CHALLENGES

Goiania is the sixth largest city of Brazil in size, with 256.8 km² of urban area, and the twelfth largest city in Brazil. The city has more than 1.3 million inhabitants. The Metropolitan Region of Goiânia has 2,172,497 inhabitants, making it the tenth most populous metropolitan area in the country. The economic sectors that are the most prominent are retail, food and clothing industries and services. The proximity to Brasília and the location in the center of one of the world’s largest agropastoral areas of the world make local economy very dynamic (IBGE, 2010).

The urban public transport system is run in conjunction with local governments of other cities in the metropolitan region and the state government, being restrict to urban and semiurban bus lines. The agency responsible for the management of the system is the Metropolitan Mass Transport Network (MTMN).

In October 2010, more than 19 million trips on the unicipal and intermunicipal transit system were performed. About 9 million kilometers were traveled by vehicles of the system. The total fleet of the system is 1,335 vehicles, whose average age is 3.8 years.

The MTMN consists of 281 bus lines, with a model of physical-wide integration charges between them, structured through 20 terminals and integration of hundreds of electronic connection points, distant places of maximum integration 1000 meters any residence, which allows us to serve any desire to travel to any destination across the metropolitan area, paying up a single integrated fare (MTMN, 2011).
The purpose of the construction of the BRT system in Goiânia is the design of transport corridors that are integrated into the existing network. The system’s design plans for the implementation of dedicated lanes for mass transportation by bys and the replacement of the current fleet with greater capacity vehicles in order to adequately meet the demand of passengers who will use these corridors.

The system plans for the optimization of the operation in the corridors, with anticipated collection of fares, building of stations with raised platform (facilitating access to vehicles), and adoption of a new logistics operating with service express and semiexpress lines.

In the BRT Corridor in Goiânia an investment of R$237 million is planned. Most funds will come from the federal government, through the Mobility PAC (R$ 98 million). In return, the municipal government will invest R$95 million. There are no estimated values for expropriations.
GENERAL CHARACTERISTICS OF BRT CORRIDORS

With 27km in length, the North-South BRT will have investments amounting to R$ 182 million in construction works and R$7 million in equipment control and e-ticketing. The total investment in fleet acquisition will be R$ 25 million, and the amount to be invested in the construction of terminals will be R$47 million.

The basic project is being drafted and scheduled for completion in August 2011. The executive project is also being drafted and will be finalized in January 2012. The operational design is completed.

The bidding notice should be ready by September 2011, with tender in December 2011 and construction works contracts to be awarded in January 2012.

BRT CORRIDORS’ PHYSICAL DESIGN

All corridors will be build with rigid pavement (concrete) in order to support an increased traffic. Along the corridor, 7 integration terminals and 40 stations will be built, with an average distance of 600 meters between them. There will be overtaking lanes in all stretches between stations. Integration with non-motorized modes will occur through the implementation of bike paths along the corridor and construction of bike parking racks at integration terminals. The sidewalks along the corridor will be treated in order to improve accessibility.
Longitudinal section - BRT Corridor
BRT CORRIDORS OPERATION

The corridors will be positioned near the median strip and will be for the exclusive use of bus vehicles. In it stopping lines will operate and semi-express on a trunk system, that will use 135 conventional vehicles, 26 standard type and 35 articulated. The estimates are that 11.8 thousand passengers will be transported at peak hours, while daily demand will reach 112 thousand passengers a day.

It is estimated that with the implementation of the BRT corridors, vehicles will have an operating speed of 24km/h (current speed is 21km/h) as they will be in exclusive lanes and under computerized control. The fare will be charged before boarding, which will reduce the waiting time of vehicles at stations.

The priority of circulation of buses at intersections on the corridor will be made through the implementation of intersection control. The Control and Monitoring Center will be responsible for controlling travel timetables at the terminals, overseeing the operation of the lines, among other operational inspection activities. There will also be electronic information service for passengers.

BRT SYSTEM BUSINESS PLAN

Companies that will operate the corridor will be private. The form of remuneration of the operation will be through the collection of fares. There will be no Compensation Chamber. The current fare is R$ 2.50 and it will not be subsidized.

There are plans to build parking lots integrated to the BRT corridor, but other businesses such as commerce at the terminals will be implemented. For investment in the fleet is planned the combination of of public and private funds. Only public funds will be used in infrastructure investment.
INTERFACE WITH URBAN PLANNING

This corridor is one of the axes proposed in the Master Plan for Urban Transport in Goiânia. No studies of neighborhood impact have been made yet, and there is no prospect of joint urban operation. With the implementation of the corridor, the adjacent physical space will receive urban treatment: treatment of sidewalks, expansion of public lighting, integrated landscaping. The North-South BRT primarily serves underserved neighborhoods and regions dependent on mass transportation in the south region of Aparecida de Goiânia and the northwestern region of Goiânia.

ENVIRONMENTAL ASPECTS

The Environmental Impact Assessment is still under development and is scheduled for completion in December 2011. The environmental permit will be issued in November 2011. A reduction of 1,407 tons in emissions of pollutants into the environment is expected. The vehicles will operate on biodiesel.
MARINGÁ, STATE OF PARANÁ

CONTEXT AND CHALLENGES

Maringá is the third largest city of the state of Paraná and the seventh most populous in the southern region of Brazil. It has a population of 357 thousand inhabitants and an urban area of 128km². The local economy is based on commerce and services (IBGE, 2010).

In recent years, efforts have been observed to improve the quality of transports in the city. Currently, the fare is R$2.20 for whoever owns a "Passe Fácil" (easy pass) electronic card and R$2.60 for those paying the fare in cash on common buses. Another way adopted to improve traffic was the Binary System, which altered the direction of avenues Sao Paulo, Herval, Duque de Caxias and Paraná. The transport system of Maringá is currently run by only one company. The entire system is operated radially, i. e., the lines have the city’s downtown (Municipal Urban Terminal) as final destination, having hitherto only three lines connecting the neighborhoods directly (PMM, 2011).
BRT PROJECTS OVERVIEW

In Maringá R$18 million will be invested in the implementation of the BRT corridor, which will be 11km long and is scheduled for completion in September 2014.

BRT corridors

Fonte: LOGITRANS PROJETO BÁSICO 2010
GENERAL CHARACTERISTICS OF BRT CORRIDORS

For implementation of the North, East and West Transport Corridor R$10 million will be invested in construction works and the investment in terminals will be approximately R$8 million.

The conceptual design of the corridor is ready, since it is part of the Basic Design of Transportation. However, the corridor no operational design elaborated, as well as basic and executive projects. The bidding document was not drafted and thus the works were not tendered or contracted.

BRT CORRIDORS’ PROJECT PHYSICAL DESIGN

Along the corridor 3 integration terminals and 13 stations will be built, with an average distance of 700 meters between them. There will be a treatment of sidewalks along the corridor, which will facilitate access to stations and terminals but there is no expectation of building bike paths. The corridor will have areas for vehicle overtaking and will not provide public services to users of public transportation.
Longitudinal section of the Corridor - Imagem Slomp & Busarello Arquitetos
Front View of the Corridor
BRT CORRIDORS OPERATION

The corridors will be positioned near the median strip and will be for the exclusive use of bus vehicles. In it will stopping lines operate. 9 articulated and 8 standard vehicles will be used. It is estimated that demand at rush hours will be of 25 thousand passengers and there will be 125 thousand passengers on a daily basis. The services will operate with 5 minutes headway at peak hours.

The current speed of buses in operation is 15km/h (approx. 8 miles/h), and the expected average speed in the corridor is 21km/h (approx. 13 miles/h). The fare will be charged before boarding at closed stations. The Control and Monitoring Center will be responsible for the control of travel timetables at the terminals, overseeing the operation of the lines, among other operational inspection activities. The corridor will not be equipped with intersection control.

BRT SYSTEM BUSINESS PLAN

The private sector will be responsible for the operation at the BRT corridor, and the fare will not be subsidized. No Chamber of Compensation will be implemented.

INTERFACE WITH URBAN PLANNING

The adjacent physical space will receive urban treatment such as revitalization of sidewalks, implementation of bike paths, and landscaping readjustment. The routes where the corridor will be implemented will be revitalized. The implementation of the corridor will improve the accessibility of the city and will bring benefits such as comfort and safety for passengers. One of the problems found in the implementation of the corridor is fund raising.

ENVIRONMENTAL ASPECTS

The Environmental Impact Assessment has not been prepared to date. With the operational optimization of the fleet a reduction of the emission of pollutants into the environment is expected.
PORTO ALEGRE, STATE OF RIO GRANDE DO SUL

CONTEXT AND CHALLENGES

Porto Alegre has a population of 1.4 million inhabitants and covers an area of almost 500 km². It has diverse geography, with hills, lowlands and a large lake, the Guaiba (IBGE, 2010). About 700 thousand vehicles operate in the state’s capital of Rio Grande do Sul (DENATRAN, 2011).

Due to the geographical situation of the city, which is limited to the west by the lake and to the south and east by hills, the urban distribution is concentrated along a single axis of growth toward the north. Therefore, in this axis are located the major highways and railways. Along these routes, several cities in the metropolitan region of Porto Alegre have grown in recent years.

The transport sector is managed by the Public Transport and Circulation Company (EPTC). The population is served by a fleet of 1,592 buses, 403 jitneys (vans or minibuses), 618 school transport vehicles and taxis 3923. The buses operate in 364 lines, carrying about 1.1 million passengers per day. Of these buses, 371 have adaptations for people with physical disabilities and 359 vehicles have air-conditioning. The jitneys run 46 lines, carrying 56,000 passengers a day. A fleet of school buses serves 392 registered schools and 15,824 students (PMPA, 2011).
BRT PROJECTS OVERVIEW

The three existing corridors (Protásio Alves, Bento Gonçalves and João Pessoa) will be modernized and along with the new ones (Padre Cacique Avenue-Praia de Belas and Tronco Avenue), will be part of a trunk fed system forming a structural network to streamline, integrate and modernize the public transportation system. The proposed network structure streamlined with physical, operating and fare integration, will promote significant reduction in the number of overlapping bus lines on the main routes and in the central area, resulting in significant reduction in the number of buses in circulation, increased speed and reduced pollution, accidents and costs.

The purpose of the construction of the BRT system in Porto Alegre is the design of transport corridors that are integrated into the existing network. The system’s design plans for the implementation of dedicated lanes for mass transportation by buses and the replacement of the current fleet with greater capacity vehicles in order to adequately meet the demand of passengers who will use these corridors. In this aspect, the bus technology potential was explored to properly meet the demand and also the specific conditions of the road system.

The system envisages the optimization of the operation in the corridors, with anticipated collection of fares, building of stations with raised platform, and adoption of a new logistics operating with express and semiexpress lines.

In the implementation of the BRT system in Porto Alegre an investment of R$667 million is planned. Federal funds correspond to most of the investment (Pro-Transport R$480 million), which will also include municipal funds (R$53 million). The funds earmarked for expropriation amount to around R$43 million. The construction of the initial phase (modernization of existing corridors) has been initiated and is scheduled for completion in December 2013.
GENERAL CHARACTERISTICS OF BRT CORRIDORS

Based on the current transport network, which has 55km of corridors equipped with dedicated bus lanes, modernization and expansion as part of the Network Integrated Multimodal Structural Plan is part of the Integrated Transport and Urban Mobility - PITMUrb that meets the guidelines transport of PDDUA. The system will also benefit the municipalities of Cachoeirinha, Gravataí, Alvorada, Eldorado do Sul and Guaíba.

The investment in construction works will be approximately R$200 million, of which R$ 187 million funded by the Andean Corporation of Foment (CAF). For the implementation of control and e-ticketing equipment R$14 million will be invested. The basic and executive projects are under development, scheduled for completion in December 2011. The bidding notices are expected to be completed in December 2011 to award construction works contracts. The operational projects are in preparation.

### Corridor Investments (R$) Expectation of completion

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Investments (R$)</th>
<th>Expectation of completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protásio Alves</td>
<td>15,726,275</td>
<td>October, 2013</td>
</tr>
<tr>
<td>Bento Gonçalves</td>
<td>14,424,598</td>
<td>June, 2013</td>
</tr>
<tr>
<td>João Pessoa</td>
<td>32,500,000</td>
<td>October, 2013</td>
</tr>
<tr>
<td>Avenida Padre Cacique - Praia de Belas</td>
<td>19,300,000</td>
<td>September, 2013</td>
</tr>
<tr>
<td>Tronco Avenue</td>
<td>139,000,000*</td>
<td>December, 2013*</td>
</tr>
</tbody>
</table>

* Data obtained from the Transparency Portal (portaltransparencia.gov.br)
BRT CORRIDORS’ PHYSICAL DESIGN

The corridors will be constructed with rigid pavement (concrete). At the end of the process of implementation of the BRT system, 12 terminals and 88 integration stations with 400 meters distance between each other, will be operating in an integrated manner. There are no overtaking areas between BRT stations. There is no plan to implement bike paths along the corridor, bike racks will be built at integration terminals. Also, sidewalks along the corridor are not expected to receive treated.

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Length (km)</th>
<th>Stations</th>
<th>Terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protásio Alves</td>
<td>7,5</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Bento Gonçalves</td>
<td>6,5</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>João Pessoa</td>
<td>3,2</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Avenida Padre Cacique - Praia de Belas</td>
<td>5,8</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Tronco Avenue</td>
<td>5,3</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

NA: Not available

BRT CORRIDORS OPERATION

The corridor will be positioned near the median strip and will be for the exclusive use of bus vehicles. In it will operate stopping lines and articulated vehicles in a trunk system. Fares will be charged inside the vehicles. The priority of the movement of vehicles on the corridor will be guaranteed with the implementation of intersection control.

The Control and Monitoring Center will be responsible for controlling travel timetables at the terminals, overseeing the operation of the lines, among other operational inspection activities.
At the terminals there will be electronic information services that will assist users in identifying the lines, schedules, destinations and other operational information, and there will be as well the provision of public services.

**BRT SYSTEM BUSINESS PLAN**

The private sector is responsible for operating the BRT corridor, and the form of compensation for the operator is exclusively the bus fare. Fare charging will be controlled by private enterprise. Currently the fare is R$ 2.70, and there will be no subsidies in BRT corridor system.

A Compensation Chamber will be implemented, which will be responsible for remunerating the operators and associated businesses to the operation of the corridor are expected. Construction of parking lots integrated to the corridors is envisaged.

**INTERFACE WITH URBAN PLANNING**

No neighborhood impact studies have been made yet, and there is no expectation of a joint urban operation. However, on the other corridors, the physical space adjacent to the corridors will receive urban treatment, in order to reconcile the different land uses along the corridor.

This corridor will not give access to any population living in an Area of Special Social Interest.

**ENVIRONMENTAL ASPECTS**

The Environmental Impact Assessment is still under development and is scheduled for completion in December 2011. Moreover, the buses will operate with diesel fuel and it is hoped that, with the optimization of the system and the consequent reduction in the volume of buses in circulation in the central area and in the transportation axes, there will be direct benefits to the environment (pollutant reduction emission).
Recife is the most densely populated metropolis of Brazilian Northeast and the third in the country. It has more than 1.5 million inhabitants (IBGE, 2010). The city covers 218km² and plays a strong role as an economic center in the state and region of Pernambuco. (IBGE, 2010). Commercial activities and services are predominant and correspond to 95% of the entire value of the generated wealth.

The central area of the city of Recife is completely overcrowded, as it houses an area of approximately 10km², where about 1,600 buses perform 15,500 trips/day. Every day, about 2.2 million users use public transport service in the Metropolitan Region of Recife.

The Public Passenger Transport System of the Metropolitan Region of Recife (STPP / RMR) currently consists of bus and subway systems. There are 360 specific lines of public transportation by bus and two subway lines: Downtown Line (with two branches, with two branches, one to Jaboatão and another one to Camaragibe) and South Line, starting from downtown Recife and extending to Cajueiro Seco. Of the 360 existing bus lines in STPP/RMR, 240 are radial, connecting various districts or municipalities in the metropolitan area to downtown Recife.
The metro is operated by a federal public company, and 18 other private companies operate the lines of the public transport system by bus. The Greater Recife Transport Consortium (GRCT) is the agency responsible for both supervising and controlling the entire system, as per the definition of the Service Operation Orders, which must be met by the operating companies.

Small Size Vehicles (SSV), with total capacity between 12 and 20 people, complement public mass transportation. This service is regulated by the Municipal Government of the City of Recife and the GRCT and carry on average 33,790 passengers a day across the entire metropolitan area.
BRT PROJECTS OVERVIEW

BRT projects are part of the PlanMob-Recife, which seeks to encourage a policy of urban occupation towards further intensification in the vicinity of mass transportation corridors, which concentrate a great flow of passengers.

- The system anticipates the optimization of the operation in the corridors through various alternatives, among which are:
  - System of fare collection prior to boarding;
  - Construction of stations with platform elevated raised to boarding level;
  - Use of fleet of articulated vehicles and raised floor; and
  - Semaphoric system control.
The three BRT corridors are under the responsibility of the state government and its construction works started in November and December 2011. Completion of construction works is scheduled for May 2013.

The North-South Corridor will have a length of 33km and will include the following municipalities: Igarassu, Itamaracá, Itapissuma, Araújoaiba, Abreu e Lima, São Paulo, Olinda and Recife. This corridor will be responsible for connecting the Northern Metropolitan Region of Recife (RMR) with the Cidade da Copa (World Cup’s Village in Recife) and the new stadium. The corridor will also include access to important hubs of tourist attraction, such as hotels, airport, railway and subway stations, as well as other possible alternatives of displacement on the network of Integrated Structural System (SEI).

The total investment in the construction of the North-South Corridor is approximately R$ 159 million. Civil works alone will account for R$ 147 million, and the remaining R$ 12 million will be employed
on the construction of the needed terminals. The basic project is complete, and the executive project has its completion scheduled for the month of January 2012. With the bidding notice already prepared, the construction work is tendered and contracted and its operational project is finalized.

Regarding the East-West Corridor, with 12.5 km in length, the total planned investment is $165 million, of which R$154 million will be allocated to the civil works and R$11 million will be earmarked to the construction of the terminals. This corridor will allow the displacement between the eastern and western regions of the Metropolitan Region of Recife (RMR). The cities to be awarded with construction works are as follows: São Lourenço da Mata, Camaragibe and Recife. The basic project of the corridor is completed, and the completion of the executive project is scheduled to June 2012. The bidding notice is already prepared, the civil works were tendered and awarded. The operational project of the corridor is finalized.

The third corridor designed to Recife/PE is called Cidade da Copa branch line. It is 6.4 kilometers long and covers the towns of Camaragibe, São Lourenço da Mata, and Recife. This corridor is an extension of the East-West Corridor and will also cover the future Cidade da Copa, where is located the Pernambuco Arena. The total investment is R$131 million, which will exclusively be devoted to civil works. The basic design is finalized, however the executive and operational projects have not been completed. With the bidding notice already prepared, the construction work is tendered and awarded.

**BRT CORRIDORS’ PHYSICAL DESIGN**

The designs of the three BRT systems planned for the city of Recife/PE are part of the infrastructure works of urban mobility for the 2014 World Cup. The projects anticipate operation along the median strip and areas intended for overtaking in order to achieve greater operational speed and optimization of the fleet of vehicles to be used. Along the corridors, in the impacted urban areas, there will be the provision of public services to be used by users. The pavement to be used in all the works will be mixed (concrete and asphalt).

In the North-South Corridor will be built a new terminal and 3 others will be renewed to adapt to operation of the BRT system. The design contemplates the construction of 31 stations along the total route 33 km long, they will be spaced every 500 meters.

For the East-West Corridor two new integration terminals will be built, and 2 are already renovated. The total number of stations will be 22 along the 6.4 km, with a distance of 500 meters between them.

As to the Cidade da Copa branch line corridor, it will be awarded with 1 new terminal integrated with the subway system. 4 stations will be built along the length of 6.4 km, also spaced 500 meters from each other, as well as other planned corridors.

An important feature of the corridors is the planning of public transport system by bus integrated with non-motorized transport. Bike paths will be implemented in all corridors in order to
stimulate the integration with public transport. The infrastructure designed for cyclists also includes the construction of bike racks to accommodate bicycles. The planned network of bike paths will have a feeder characteristic in the North-South Corridors and the Cidade da Copa branch line.

The urban planning projects of the BRT systems also consider the movement of pedestrians through a different treatment. The sidewalks will be remodeled in order to provide greater convenience to displacements of pedestrians and safety during the access to loading and unloading stations.
BRT CORRIDORS OPERATION

All corridors will be provided with exclusive lanes for bus traffic. The lines are, according to their operational characteristics mostly express and semiexpress. Stopping lines also exist in all corridors. In the chart are the main characteristics of BRT systems designed.

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Passenger Demand (Daily)</th>
<th>Passenger demand (Peak Hours)</th>
<th>Frequency at Peak (vehicles/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North-South</td>
<td>145.9 thousand</td>
<td>14.5 thousand</td>
<td>231</td>
</tr>
<tr>
<td>East-West</td>
<td>126.5 thousand</td>
<td>12.6 thousand</td>
<td>180</td>
</tr>
<tr>
<td>Cidade da Copa branch line</td>
<td>40 thousand</td>
<td>NI</td>
<td>NI</td>
</tr>
</tbody>
</table>

NI - Not Informed.
The operation of the public transport system by bus may offer a faster service than the planned for BRT systems. The payment of fares will be made in advance at all stations and terminals.

Currently, the average recorded speed on lines operating in the North-South and East-West corridors’ region is 18 and 15km/h respectively. With the changes in the configuration of the system and the attributes that will be introduced, the objective is to achieve average speeds of 40 to 30km/h for concerned corridors.

All the three corridors to be implemented will have intersection control system, monitored by the Operational Control Center (OCC).

**BRT SYSTEM BUSINESS PLAN**

The design of the BRT systems defined the Fare Compensation Chamber as form of remuneration. The fares will not be subsidized and the entire collection will be performed by the private sector, i.e., by the operators themselves. There will not be parking for cars along the route of the corridors. There is the prospect of partnering with other forms of business such as certain trade businesses and use of advertising located at stations and terminals.

**INTERFACE WITH URBAN PLANNING**

BRT systems were designed based on the guidelines of the city’s Master Plan. In this sense, the corridors will be the main structural transportation axes defined by the primary guiding document on urban expansion. There is no Neighborhood Station in East-West BRT Corridor.
Impact Study (NIS) prepared for the East-West Corridor and Cidade da Copa branch line. In the specific case of the North-South Corridor there is also no NIS produced because there is already a corridor with a conventional buses in operation. Joint urban operations are not planned for the corridors. The access to stations and integration terminals will receive treatment toward their improvement.

ENVIRONMENTAL ASPECTS

The Cidade da Copra branch line had its Environmental Impact Assessment (NIS) completed. To the North-South and East-West corridors impact assessment instrument does not apply.
RIO DE JANEIRO, STATE OF RIO DE JANEIRO

CONTEXT AND CHALLENGES

In recent years, the metropolitan region of Rio de Janeiro has undergone continuous transformations in terms of the socioeconomic profile of the population. According to the IBGE, in 2010 the city of Rio de Janeiro had more than 6.3 million residents and more than 2.1 million vehicles (DENATRAN, 2011). With the increasing number of vehicles in circulation, the city of Rio de Janeiro faces long, serious problems of congestion and poor traffic flow.

The current mass transportation system is diverse and has different services to meet the existing demand. The system allows the integration of services, which implies increased economic and financial efficiency. The need for improvements in the mass transportation system of the city stands out even more because the city of Rio de Janeiro is one of the venues of the 2013 Confederations Cup and the World Cup in 2014, as well as the main stage of the Olympic Games in 2016.

The system of regular passenger transport by bus in the metropolitan area comprises 136 companies, of which 102 are acting within the limits of the municipality and 63 operating intercity services, and employ 16,772 vehicles, in which 66% of them operate 724 municipal lines and the rest of fleet, 565 intercity lines. In 2008, the system carried 119 million passengers and 4.5 million monthly passengers a day. For 2007, there was a drop of 26.7% in passenger demand (FETRANSPOR, 2011). The current fare of the system ranges from R$2.50 to R$4.40. Em relação a 2007, houve uma queda de 26,7% na demanda de passageiros (FETRANSPOR, 2011).
BRT PROJECTS OVERVIEW

The purpose of the construction of the BRT system in Rio de Janeiro is the design of transport corridors that are integrated into the existing network. These mass transportation corridor systems consider the increase in demand over time, as well as the appropriate technology to meet this demand.

The system design plans for the deployment of dedicated lanes for mass transportation by bus to the left of the vehicle flow, thus avoiding conflict with the use of the bordering land (overtakes on the right, entrance and exit of commercial and residential establishments, for instance).

The system plans for the optimization of the operation in the corridors, with anticipated collection of fares, building of stations with raised platform, and adoption of a new logistics operating with service express and semiexpress lines.

Due to lack of access to detailed information about one of the corridors (Transolimpica), this technical dossier focuses on the technical description of the 3 main BRT corridors. It is estimated that R$1.8 billion will be invested in implementing these corridors.

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Funds (in R$ million)</th>
<th>Length (km)</th>
<th>Expectation of completion</th>
<th>Jurisdiction</th>
</tr>
</thead>
<tbody>
<tr>
<td>TransOeste</td>
<td>770</td>
<td>74</td>
<td>2012</td>
<td>Municipal Government</td>
</tr>
<tr>
<td>TransBrasil</td>
<td>1,300</td>
<td>27</td>
<td>2014</td>
<td>Federal, State and Municipal Governments</td>
</tr>
<tr>
<td>TransCarioca</td>
<td>1,300</td>
<td>39</td>
<td>2014</td>
<td>Municipal Government</td>
</tr>
</tbody>
</table>

The construction works of TransOeste and TransCarioca corridors are already in progress, with funding from the municipal government. On TransBrasil Corridor, most investments are funded by the federal government (R$ 800 million), which will be complemented by state government (R$ 330 million) and municipal (R$ 170 million) investments. The expropriations necessary for the implementation of the corridor will amount to approximately R$20 million. The start of construction works is planned for 2012 with state and municipal funds. Also for the implementation of the TransCarioca Corridor most funds are fomented by the federal government. State and municipal governments will complement with R$200 million. Construction works began in March 2011, with municipal funds. The expropriations necessary for the implementation of the corridor will amount to approximately R$300 million.
Network Map
GENERAL CHARACTERISTICS OF BRT CORRIDORS

The TransOeste Corridor will be the main connection between the west of Rio de Janeiro and some neighborhoods in the north, near Brasil Avenue. The basic and executive projects have been prepared and construction works have been tendered and awarded. The operational project is complete and anticipates a trunk-fed system.

The TransBrasil Corridor is an important connection between Baixada Fluminense (feeder roads) and downtown Rio de Janeiro. The basic project is completed, and completion of the executive is scheduled for 2011. The bidding notice of the construction works is scheduled for completion in 2011, with an expectation of awarding the contracts in 2012. The operational project has not been elaborated yet, but it is expected to be finished by 2011.

The TransCarioca Corridor is a major link between the International Airport Tom Jobim and Barra da Tijuca. The corridor will serve other districts such as Madureira and Penha, important areas of the city. The basic and executive projects were completed and the construction works contracts awarded in March 2011. The operational project anticipates a trunk-fed system.

BRT CORRIDORS’ PHYSICAL DESIGN

All corridors will be build with mixed pavement (asphalt and concrete) in order to support an increased traffic.

In the TransOeste corridor 6 integration terminals and 74 stations will be built along its entire length. In Transbrasil 5 integration terminals and 27 stations will be built, with an average distance between them of 1.350m. On the TransCarioca Corridor 3 integration terminals and 39 stations are expected to be built, with an average distance of 812.5 m between them. The projects envisage the existence of areas for overtaking on the stretches between stations, ensuring operational speed along the corridor. Having as premise the incentive to mobility by non-motorized modes as well, the construction of bike paths along the corridor is planned. The integration between BRT and bicycle mode occur through the construction of bike racks on all integration terminals. For pedestrians, the project of implementation of the BRT envisages the treatment of the sidewalks along the corridor.
O corredor apresenta uma faixa por sentido ao longo de todo o trecho, com duas faixas por sentido nas estações.
BRT CORRIDORS OPERATION

All BRT corridors will be operating on the left and for the exclusive use of vehicles buses, which follow the system specifications. In it will operate express, semi-express and stopping lines in a trunk-fed system.

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Fleet (vehicles)</th>
<th>Peak hours demand (passengers)</th>
<th>Daily demand (passengers)</th>
<th>Peak hours frequency (vehicles/h)</th>
<th>Frequency between peaks (vehicles/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TransOeste</td>
<td>230 articulated</td>
<td>50 thousand</td>
<td>500 thousand</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>TransBrasil</td>
<td>450 articulated</td>
<td>110 thousand</td>
<td>1 million</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>TransCarioca</td>
<td>250 articulated</td>
<td>50 thousand</td>
<td>500 thousand</td>
<td>200</td>
<td>100</td>
</tr>
</tbody>
</table>

With the implementation of the corridors, the operating speed of the buses will be higher. Currently the speed of the buses that operate in the stretch where TransOeste is implemented is 25km/h, but the expectation is that the corridor will operate at 34km/h. As part of the implementation of the TransBrasil Corridor the current speed of the bus is 23km/h, but there is an expectation that the corridor will operate at 36km/h. As part of the implementation of the TransCarioca Corridor the current speed of the bus is 17km/h, but there is an expectation that the corridor will operate at 29km/h.

The fare collection will be made at the stations before boarding onto the vehicle, which will passengers boarding onto the vehicles. Intersection control is not expected to be implement. In the 3 corridors, the Control and Monitoring Center will be responsible for controlling travel timetables at the terminals, overseeing the operation of the lines, among other operational inspection activities. At the terminals there will be electronic information services that will assist users in identifying the lines, schedules, destinations and other operational information.

BRT SYSTEM BUSINESS PLAN

Companies that will operate the corridor will be private. The form of remuneration of the operator will be the fare on the TransOeste and TransCarioca corridors, and the combination of fare and distance traveled on the TransBrasil Corridor. There will be a Chamber of Compensation of Revenue and Credit responsible for the remuneration of the operators. The entire collection will be controlled by the private sector and the fare will not be subsidized only on the TransOeste Corridor. Construction of automobile parking lots integrated to the corridors is anticipated.
INTERFACE WITH URBAN PLANNING

The corridors are part of the transport axes proposed in the Urban Development Master Plan (PDDU/2008). Only for the Transbrasil Corridor was done the Neighborhood Impact Study, which did not identify the need for actions to mitigate impacts.

The physical space adjacent to the urban corridors will receive urban treatment in order to combine the various usages along the corridor, with the implementation of bike paths, improvement of sidewalks, revitalization of parks, construction of ramps and walkways among other measures aimed at improving urban mobility and accessibility along the corridors.

On the TransCarioca corridor measures to improve accessibility are planned, with the extension of roads for cars (including overpasses). In this corridor project is scheduled for construction of 9 bridges 2 underpasses and 10 overpasses.

ENVIRONMENTAL ASPECTS

The Environmental Impact Assessment has been prepared and approved for the TransOeste and TransCarioca corridors. To date this information is not available for the Transbrasil Corridor.

The vehicles that will operate in the corridors will be diesel, but there is an agreement with BNDES to study the use of new alternative fuels.
Salvador is a national metropolis with over 2.6 million inhabitants, the largest city in the Northeast, the third most populous of Brazil and the eighth most populous in Latin America. The city has an area of 706.8 km². Salvador’s economy is largely associated with the service sector (80% of the total) (IBGE, 2010).

With a fleet of 656 thousand vehicles (Denatran, 2010), the city faces problems common to large cities: slow traffic, especially during peak hours. With urban expansion and population growth both in the city of Salvador and the other cities comprising the metropolitan area, the needs of the inhabitants of displacement have increased and the pattern of urban travel has become more complex.

The current System of Mass Transportation by Buss (STCO) is diversified and has different services to meet the existing demand. There are 18 companies operating 2,371 vehicles and 478 lines. Each month, about 37 million trips are made, corresponding to 18 million kilometers. The STCO includes fare benefits for students (students pay half the price of the fare) and gratuities for the elderly and people with special needs. A single fare (R$ 2.50) is adopted for all lines within the system. There are three types of fare integration currently charged in Salvador. They are:
– Closed integration between trunk and feeder lines;
– Open integration through e-ticketing with the use of the Salvador Card, between direct lines of the conventional subsystem; and

– Open integration through e-ticketing with the use of the Salvador Card between short length lines operated by minibuses called “Amarelinhos”, with payment of only one fare (setps, 2011).
BRT PROJECTS OVERVIEW

The purpose of the construction of the BRT system is the design of transport corridors that are integrated into the existing network. According to the Urban Development Master Plan (PDDU) of the city, elaborated in 2008, implementation of mass transportation corridor systems will consider the increase in demand over time, as well as the appropriate technology to meet this demand.

The system design plans for the deployment of dedicated lanes for public transport by bus to the left of the vehicle flow, thus avoiding conflict with the use of the bordering land (overtakes on the right, entrance and exit of commercial and residential establishments, for instance).

The implementation of the system of exclusive corridors for buses also includes the replacement of the current fleet of vehicles with higher capacity vehicles. In this sense, the potential of bus technology is explored to correctly meet as well the specifics of the conditions of the road system.

The system envisions the optimization of the operation in the corridors, with anticipated collection of fares, building of stations with raised platform, and adoption of a new logistics operating with service express and semiexpress lines.

In order to serve the capital of Bahia and the city of Lauro de Freitas, projects of Integrated Transport Network (RIT) fund investments to the amount of R$ 3.4 billion. Of that total, about R$680 million would be used in the construction of terminals and more than R$2.2 billion in other civil works (lane bus stops/connection). It is estimated that the installation of control equipment and ticketing would consume R$115 million, while investment for the purchase of the fleet would be R$272 million. Investments in Garages, maintenance yard, logistics and training would total more than R$105 million.

Originally, the total funding for the implementation of the RIT would occur through Large Cities Mobility PAC of the Federal Government, which would provide R$ 2.4 billion. About R$542 million would also be provided by the state government. The private operator of the system would contribute with more than R$467 million. It is estimated that the implementation of the RIT system would require expropriation of around R$30 million.
GENERAL CHARACTERISTICS OF BRT CORRIDORS

The basic and operation projects have been completed by the Union of Passenger Transport Companies in Salvador (SETPS) and the Urban Development Company of the State of Bahia (Conder). To date, the executive projects have not yet been elaborated.

BRT CORRIDORS' PHYSICAL DESIGN

All corridors have been designed with the adoption of rigid pavement (concrete), in order to support the increased traffic of vehicles. 151 stations are planned, where the average distance between them would be 700 meters. Overtaking lanes are planned to facilitate the traffic of on vehicles BRT corridors. The RIT system would have a total length of 78, which would have 26 integration terminals.

Tipologia Viária

- Canaleta
- Porta à esquerda
- Ultrapassagem nas paradas

Road typology - Salvador BRT
BRT CORRIDORS OPERATION

Under the responsibility of Transalvador, all corridors would have the operation at the median strips of the roads. BRT corridors would be for the exclusive use of diesel and biodiesel driven buses. In them will operate express, semi-express and stopping lines. The fleet would use articulated vehicles.

The total projected demand of passengers (daily average) would be 600 thousand. At peak hours, it is estimated that 79,993 passengers would use the system. The project establish a 3 minutes bus frequency at peak hours, whereas between peaks it would be about 7 minutes.

Having as premise the incentive to mobility by non-motorized modes as well, the construction of bike paths along the corridor is planned. The integration between BRT and bicycle mode occur through the construction of bike racks on all integration terminals. The expectation of provision of other public services such as wireless internet and shops at terminals.

The system will feature an electronic information service, with monitors at stations informing the arrival and departure of vehicles, major services, integration types and other information relevant to the operation of transport services.
The priority of circulation of buses at intersections on the corridor will be made through the implementation of intersection control. The Control and Monitoring Center will be responsible for controlling travel timetables at the terminals, overseeing the operation of the lines, among other operational inspection activities.

It is estimated that with the implementation of the BRT corridors, vehicles will have an operating speed of 30km/h as they will be in exclusive lanes and under computerized control. This represents a considerable increase in regard to the present speed (16km/h). Moreover, with the fare collected before boarding, the waiting time of vehicles at the stations would be reduced, which would contribute to further increasing the efficiency of the RIT.

BRT SYSTEM BUSINESS PLAN

The form of remuneration of the operator is the combination of fare, with the implementation of a Compensation Chamber of Revenues and Credits, which will be responsible for the remuneration of the operators. The fare will not be subsidized and the whole collection will be private.

The construction of parking lots integrated into the BRT corridor is envisaged, and the fare charged will be based on the value of the integrated fare.
INTERFACE WITH URBAN PLANNING

The corridors are axes proposed in the Urban Development Master Plan (PDDU/2008). No Neighborhood Impact Study have been made, but with the implementation of the corridors the adjacent physical space will receive urban treatment. One of the goals is to treat conditions of infrastructure, improving accessibility conditions in the area near the corridor.

ENVIRONMENTAL ASPECTS

There is a concern with the index of pollutant emissions from vehicles. Thus, vehicles that will operate on the corridor will use biodiesel and diesel fuel.

So far there is no information about the environmental impact that the implementation of the corridors will cause, since specific studies to verify this (Environmental Impact Study) have not been performed.
The municipality of Uberlândia is located in Minas Gerais Triangle and has a population of 604 thousand inhabitants. It occupies an area of 4115.82 km², of which 135 km² are in urban area. The Gross Domestic Product - GDP of Uberlândia is the 27th largest in Brazil, especially in the area of services. Other relevant sectors of the economy of Uberlândia are agriculture and industry (IBGE, 2010).

According to the preliminary version of the Transportation and Urban Mobility Master Plan of Uberlândia, the city will by the year 2020 reach a fleet of approximately 420 thousand vehicles, considering the current rate of motorization (PUB, 2006).

The transportation system of Uberlândia is trunk-feeder. It consists of a central terminal and four peripheral terminals. This structure was inaugurated in 1997 and it guides the policies of land use in the city. The system comprises 114 lines, with a fleet of 395 vehicles, performing 5318 trips per day and 93,588 km per day. These services carry 220 thousand passengers a month. E-ticketing is used throughout the system.

In September 2006 began the New Concept in Urban Transport with the implementation of the Structural Corridor of João Naves de Ávila Avenue. This concept is characterized by meeting the needs of displacement of people through the integrated treatment and has four important principles:
- Pedestrians: Priority crossing / Sidewalks / Access to stations;
- Bus: Exclusive lane / Closed Stations / Transfer Stations;
- Cars: Traffic safety / Traffic Fluidity; and
- Environment Landscaping / Noise level.
BRT PROJECTS OVERVIEW

With the excellent results achieved by Structural Corridor João Naves de Ávila, the city government decided to expand the New Concept in Transportation, developing new BRT Corridor projects. Four additional integration terminals will be built over 4 and the following enhancements will be implemented to improve the System:

- Rigid paving in all stations;
- Cameras monitoring stations;
- Radar to control track invasion
- Education for Transport - SIT Education.

The complete system will consist of 52 km of corridors, 82 closed stations and a total of 9 integration terminals.
GENERAL CHARACTERISTICS OF BRT CORRIDORS

In the João Naves de Ávila Avenue Corridor, with 7.5 km of extension, were invested approximately R$ 6.5 million in the implementation of construction works and R$15 million to build terminals. Around R$300 thousand will be invested in the implementation of control and e-ticketing equipment.

For the acquisition of the fleet to operate in the corridor, the investment was R$5 million, and for other services an investment of R$1.1 million is expected.

BRT CORRIDORS’ PHYSICAL DESIGN

The corridor was built with mixed pavement (asphalt and concrete), in order to support more intense bus traffic.

Currently the corridor operates with 2 integration terminals and 13 stations along the corridor, with an average distance of 500 meters between them. The provision of public services in the terminals is expected.

With a view to integrate with non-motorized modes, bike paths will be built along the corridor and bike parking at the integration terminals.

Investment was made in infrastructure improvements for pedestrians along the corridor as well as the implementation of traffic moderators, aiming at the safety of pedestrians at intersections and access ramps to the terminals.

BRT station inside area
BRT CORRIDORS OPERATION

The corridors will be positioned near the median strip and will be for the exclusive use of bus vehicles. Express and stopping lanes will operate in it, using 41 standard type vehicles, 8 articulated and 2 with a low-floor buses. The demand observed at peak hours is 3583 passengers, while the daily demand reaches 21 thousand passengers. The services operate with headways at peak hours and between peaks of 3 and 5 minutes, respectively.

Originally, the speed of the buses on BRT corridors was designed to operate at around 20km/h. However, with the prioritization of the movement of buses at intersections in the corridor and intersection control, the current operating speed is 25km/h. The fare will be charged before boarding in closed stations, which will reduce the waiting time of vehicles at stations.

The Control and Monitoring Center will be responsible for the control of travel timetables at the terminals, overseeing the operation of the lines, among other operational inspection activities. The agency responsible for managing BRT corridors is the Department of Traffic and Transportation (Settran).

BRT SYSTEM BUSINESS PLAN

The private sector is responsible for operating the BRT corridor, and the form of compensation for the operator is exclusively the bus fare. Currently the fare charged is R$ 2.40 and the cost per passenger is R$ 2.12. The fare of the BRT system is not subsidized and all the collection in the system is made by the private sector.

At least 4 types of business are required to be associated with the operation of the corridor: a mix of shops, cafes, banks, and lottery.

The construction of automobile parking lots integrated to the corridors is anticipated.

INTERFACE WITH URBAN PLANNING

This corridor is one of the main structuring axes proposed in the Urban Development Master Plan (2008). There are no neighborhood impact studies, but with the implementation of the corridor the adjacent space received urban treatment, e.g., the improvement project of improvement of sidewalks and revitalization of plazas along the corridor.

Along the corridor trees were replanted and plant species were extracted for the implementation of the corridor, which made the environment more humane and pleasant. With the reduction of one traffic lane for the implementation of the corridor, adjustments were made in the intersection control and reduction of overtakings on the left.
An important social aspect of this corridor is the access to the population living in an Area of Special Social Interest. Housing complexes located in the southeast sector of the city were benefited.

Other social benefits arising from the implementation of the corridor can be mentioned. They are: reducing the number of accidents; safety; reliability; reduced boarding time; reduced travel time; vehicle technology improvement; more thermal comfort; and a more comfortable waiting time.

ENVIRONMENTAL ASPECTS

The Environmental Impact Assessment has been prepared, and all vehicles run on diesel and biodiesel. By using an exclusive lane, the operating speed of the bus is guaranteed and there is less fuel consumption, with consequent reduction in emissions.
VITÓRIA, STATE OF ESPIRITO SANTO

CONTEXT AND CHALLENGES

Vitória is part of the metropolitan area, which also includes Vila Velha, Serra e Cariacica, Fundão, Guarapari and Viana. According to IBGE (2010) data, the metropolitan area has about 1.7 million inhabitants. Over the past 10 years, the population of the metropolitan area grew by about 16%, while the fleet of vehicles doubled in the same period. The economy of Vitória is dedicated to harbor activities, active trade, industry, rendering of services and tourism business. The capital of the state of Espírito Santo has two ports that are the most important in the country: the Port of Vitória and the Port of Tubarão.

To serve the population of the entire metropolitan area, two urban transport systems have been developed over the years. The municipal system serves users only within the limits of the city of Vitória. This system has 56 bus lines distributed in 342 vehicles carrying 120 thousand passengers a day. In December 2010, more than 3.5 million users used Vitória’s bus fleet. Three companies have concession contracts to operate city buses: Greater Vitória, Tabuazeiro and Unimar (PMV, 2011). For the transport from and to the capital and other cities in the metropolitan area, the Transcol system was created. Transcol is operated by 11 companies that together make the GVBus. With 1,445 buses, the system carries 15.9 million passengers per month. Each bus travels over 6.4 thousand km a month. The system has more than 271 lines and ten integration terminals.
BRT PROJECTS OVERVIEW

The goal of BRT system implementation is the optimization of mass transportation service operation, based on the anticipated charging of the fare and the adoption of a new operational logistics, with express, semi-express, and stopping lines which will be 31km long. Most of the funds will come from the federal government, with a complement from the state government (R$ 132 million).

The main stages of implementation of the corridors are the elaboration of the basic project design, expropriations (with resources amounting to R$ 170 million), construction works (which started in 2011 with completion in 2014) and civil construction works (with resources amounting to R$ 533 million).
GENERAL CHARACTERISTICS OF BRT CORRIDORS

Greater Vitória’s BRT will be the main connection between the municipalities of Vitória, Vila Velha, Serra, Cariacica and Viana. The corridors will have a length of 31km. The total investment in the implementation of construction works will be approximately R$663 million, of which R$ 530 million are financed by BNDES (Brazilian Development Bank). The total investment in the construction of terminals will be R$61 million. For the implementation of control and e-ticketing equipment R$60 million will be invested.

The operational plan is in detailing phase, scheduled for completion in December 2011. The expected investment for fleet acquisition is R$9 million.

Greater Vitória BRT basic design is completed, and the executive project is scheduled to end in June 2012. The public notices for the construction works is in preparation and will be completed in June 2012. The expectation for signing construction work contracts is October 2012.

BRT CORRIDORS PROJECT PHYSICAL DESIGN

All of the corridors will be built on rigid pavement (concrete) and will have 10 integration terminals and 41 stations, with an average distance of 600 meters between them. In the corridors are planned overtaking areas in all parts of the BRT stations, thus preventing the formation of queues. Integration with non-motorized modes will occur by the implementation of bike paths feeding the corridor and construction of bicycle integration terminals. There will be a treatment of sidewalks along the corridor, which will facilitate access to stations and terminals.
BRT Studies in Brazil

BRT corridors
BRT CORRIDORS OPERATION

The corridors will be positioned along the median strip and will be for the exclusive use of bus vehicles. In the trunk-fed system express, semi-express and stopping lines will operate. The fleet will be made up of 7 articulated and 15 conventional vehicles which will transport 640 thousand passengers per day and 16 thousand at peak times.

The fare will be charged before boarding in closed stations, which will reduce the waiting time of vehicles at stations, by speeding up the boarding of passengers. The priority of movement of vehicles in the corridor will be guaranteed through an intersection control to be deployed. The Control and Monitoring Center will be responsible for the control of travel timetables at the terminals, overseeing the operation of the lines, among other operational inspection activities. There will also be electronic information services to provide operational information about the system for the user.

BRT SYSTEM BUSINESS PLAN

The private sector will be responsible for the operation and collection in the BRT corridor. The operator will be remunerated according to distance traveled. Currently the fare is $2.30 and serves the metropolitan inter-municipal system, serving 80% of the demand of Greater Vitória. Currently the fare is subsidized by the state government, and this grant will remain after the implementation of the BRT corridors of the Greater Vitória. The future businesses associated with the operation of the corridors are in planning stage. Construction of automobile parking lots integrated to the corridors is anticipated.
INTERFACE WITH URBAN PLANNING

Urban Development Master Plan (2008) incorporated the concept of BRT corridors. The physical adjacent space will receive urban treatment in order to reconcile its different usages along the corridor.

As part of the urban improvements along the corridor is expected to adjustment of the sidewalks, treatment of pathways near the corridors, landscaping, special lighting with a focus on pedestrian crossings and special treatment for crossing the central area of the capital. Universal accessibility will be ensured at passenger boarding/disembark stations whose platforms will be at the height of the floor of the bus.

ENVIRONMENTAL ASPECTS

The Environmental Impact Assessment is scheduled for completion in December 2011. All vehicles in the corridor will use diesel fuel.
From the description of the characteristics of the studies of BRT systems in Brazil it can be concluded that analyzed cities have worked to create reliable, efficient transportation systems and according to Brazilian economic and social reality. It is perceived that there is a concern with transforming existing services of public transport by bus into integrated systems that better exploit technological and technical advances and to promote significant improvements in the conditions of transportation of millions of Brazilians. This transformation has used the financial resources in a responsible and a transparent way. In other words, BRT systems will not generate increases in fares, which would make it inaccessible to much of the urban population. On the contrary, in some cities, an effort to reduce costs while seeking to create transportation systems of the highest quality.

Accordingly, it appears that the basic elements of BRT systems were assimilated by all cities featured in this technical dossier. All BRT systems demonstrate an understanding of the need for establishing dedicated road space, the use of stations and terminals providing comfort and safety, the operation of modern vehicles appropriate to the characteristics of passenger demand and the
implementation of information and control to improve efficiency and the operation of services and service to passengers.

Despite the incorporation of these basic elements, it appears that the BRT projects are at different stages of development. In some cases, an advanced stage was reached in terms of design, implementation and future prospects of the systems. For example, some cities have conceived it as part of long-term urban development strategies, that go far beyond those guidelines imposed by master plans. Hence, they are used not only to meet existing demands, but also guide urban growth in areas of interest. Obviously, these cities in advanced development stage have also shown excellence in the incorporation of the basic elements of the BRT systems.

On the other hand, other cities have shown some incipience in the process of adopting the BRT concept. There are several cases in which the initiatives are limited to the creation of BRT corridors and operation of high capacity vehicles. It is clear that significant benefits can be obtained through such initiatives, but there is the realization that much more could be achieved. Particularly, it would be recommended to undertake efforts to enable fully integrated systems and create corridors in areas where passenger demand is already consolidated in various fragmented services.

The local context is the main reason for the different stages of BRT system development. In towns with an advanced stage of development there is also the existence of consolidated and professionalized relationships between the various stakeholders (governing bodies, operators and society in general). Thus, the design of BRT systems directly reflected these favorable institutional conditions. However, in those cities where these relationships are not yet mature, a considerable potential to increase the quality of BRT systems was observed.
CONCLUSIONS

This technical report report the technical characteristics of the various BRT systems in Brazil. Based on data surveyed from key stakeholders, it was possible to present, in a systematic way, the diagnosis of the current stage of development of 13 Brazilian cities with BRT systems projects. It can be concluded that these cities are evolving rapidly to provide efficient systems for urban passenger transportation, which will certainly contribute to meet the expectations of the population.

It can be argued that BRT studies cataloged go far beyond the prospect of meeting the immediate demands related to the World Cup in 2014 and the Olympics in 2016. The BRT projects contribute to building systems that will become legacies for a large portion of the urban population and not only for those who will be involved in these international events. This finding is critical to the sustainability of urban public transport services and consequently for users to be serviced at low cost, high reliability and safety.

Clearly, there are many challenges in the implementation and expansion of BRT projects in Brazil. As shown throughout this technical report, we still need to create supporting structures so that good projects are financially and institutionally feasible. In particular, the need for creating practical tools that enable the financing of the construction and maintenance of all infras-
tructure associated with BRT systems is unquestionable. Unlike other modes that receive subsidies 12 times higher than those offered to urban public transport (IPEA, 2011), users are the only ones responsible for funding BRT systems. In this sense, the federal government is already preparing to support initiatives that are innovative and sustainable from the point of view of costs and benefits. On the other hand, governing bodies and operators, in many cases, show awareness and to be aligned so that resources are used efficiently.

In strictly technical terms, this technical report pointed out the need to consolidate crucial aspects to the success of BRT systems. Firstly, we can highlight the urgency of preparing more detailed projects that can easily demonstrate all construction and operational aspects, in order to dispel any doubts about the feasibility of BRT systems. Other important aspects are environmental issues, business plans and BRT brand consolidation. In these respects, it’s possible to envision a series of actions that could contribute to achieve even better results for everyone.

Thus, NTU will continue to act in order to create, publish and disseminate information and advanced knowledge about the potential benefits and technical and institutional challenges of BRT systems in Brazil.
**Logit**

Consulting firm specializing in transportation planning with over 20 years in the Brazilian market and worldwide. In the area of mobility, it develops alternatives that promote more qualification of urban space, preparing urban master plans, public transport studies, accessibility, and circulation, and infrastructure projects. Their logistics solutions are aimed at optimizing the flow of cargo and distribution of products through the development of regional master plans, multimodal cargo studies, supply chain optimization, and concession modeling.

**Logitrans**

Brazilian consulting firm founded in September 1997 with headquarters in Curitiba (PR) and subsidiaries in Argentina and Colombia. It designs projects related to urban public transport systems, urban mobility, and provides technical consultancy in training and implementation of these projects. It operates in several cities in Brazil and abroad, in countries like Argentina, Chile, Colombia, Ecuador, United States, Jamaica, Mexico, Paraguay, Venezuela, Angola, Tanzania, and Indonesia.

**Workshop**

Specializing in consulting and projects in transportation, and provides services to public and private sector. It was founded in 1990 with the mission of providing its clients with solutions in the transportation industry, always with the transparency that permeated the lives of the professionals who built the institution. It operates in transportation planning areas such as logistics, transportation management, urban design projects, bus transportation systems, metro rail systems design, road and traffic projects, transport economics, transport studies, transport operation and traffic, organization of transport companies, and project management.
Setepla

Brazilian engineering consulting company that has been developing for 44 years, studies, designs, supervision, monitoring and management of enterprises, as well as technical, economic, financial, and consulting services especially in the areas of transportation and metalworking industry. It has experience in privatizations, concessions, PPPs, etc., acting in both Government and private sectors - buyer/lessee.

Sistran

Consulting firm specializing in providing research, design and enterprise management services acting in transport engineering, road and metro rail projects, works of infrastructure, environment, buildings, architecture and urban planning, water resources and sanitation, distribution and warehousing logistics, transportation equipment, industrial engineering, information technology, control and automation, intelligent transportation systems, and implementation of projects.

Tecnotran

Consulting firm in the area of public transportation since 1984. It performs transportation planning, adequacy of the road system to the network alternatives proposed, signaling projects and adequacy of the points of embark and disembark. All studies necessary to perform these tasks are coordinated by Tecnotran technicians and software developed for tabulation, analysis and expansion of the samples by using a database. It also operates on the analysis, diagnosis, design and detailing of proposals involving the operational, economic, and institutional characteristics, control and management of mass transportation systems.

TTC

Consulting firm specializing in the development of studies and projects in the field of public and private transportation, urban traffic and road engineering, as well as urban and environmental aspects, TTC was founded in 1983. It is partner and representative, in Brazil, of EMME, Transportation Planning and STAN, and Cargo Transport Planning software systems produced by INRO Consultants, from Canada.

It operates in the sector of urban mobility, road transport. It has a specialized sector in studies on Traffic Generating Hubs (PGT). It also operates in the area of Urban and Regional Planning and has extensive experience in transportation and traffic engineering.
Vetran

It was founded in 1993. In order to tailor its services to customer needs, the work it developed range from the rapid diagnosis performed by a reduced team to the complete engineering project, including preliminary studies, drafts, projects and assistance in monitoring the implementation. It offers specialized services in urban planning, urban and regional transport planning, transport sector plans, analysis of the railway transport system, studies and projects for highways and urban roads, analysis, studies and projection of mass transit demand (Metro), transit studies and projects, engineering projects. It operates in supervision and monitoring of construction works, project management, e-ticketing systems, monitoring and management of public transport through GPS, fine processing and systems
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