TransMilenio Bus Rapid Transit System Expansion 2002-2005 – Bogotá, Colombia

D. Hidalgo
Akiris de Colombia S.A., Bogotá, Colombia

ABSTRACT: TransMilenio encompasses specialized infrastructure and permanent supervision provided by public agencies, and organized operations and advanced fare collections systems under contract with private firms. It is a high end Bus Rapid Transit System, which started operations in December 2000. Its first phase was completed in March 2002, and encompasses 470 articulated buses operating in 41 Km with exclusive carriageways with 61 stations, and 235 conventional buses in 309 Km mixed traffic local streets. In its second year of operations (2002) it transported 207 million paid passengers. Maximum daily demand has been 812,000 passengers with 35,000 passengers per hour per direction. The long term plan envisions a total of 388 Km of exclusive lanes. Currently the system is under expansion, with the construction of 40 Km of exclusive carriageways, where 335 additional articulated buses will operate, with the integration of 170 conventional buses for feeder services. Some changes have been introduced to improve infrastructure and service provision. The system will continue to improve the quality of life of the city residents, with high performance at a low cost.

RÉSUMÉ : Le projet TransMilenio comprend une infrastructure spécialisée et la surveillance permanente fournie par des agences publiques, la réalisation d'opérations organisées et des systèmes modernes de perception du prix des billets avec des sociétés privées sous contrat. Il s'agit d'un Système de Transport Rapide d'Autobus exploité depuis décembre 2000. Sa première phase a été achevée en mars 2002 et comprend 470 bus articulés fonctionnant sur 41 km en site propre avec 61 stations et 235 bus conventionnels sur 309 km de rues à circulation mixte. Au cours de sa deuxième année d'exploitation (2002), il a transporté 207 millions d'usagers payants. La demande maximum quotidienne a été de 812 000 passagers avec 35 000 passagers par heure par direction. Le projet à long terme prévoit un total de 388 km en site propre. Actuellement le système est en expansion, avec la construction de 40 km en site propre, où 335 bus articulés complémentaires fonctionneront, avec l'intégration de 170 bus conventionnels pour des services de raccordement. Quelques changements ont été introduits pour améliorer l'infrastructure et la prestation de service. Le système continuera à améliorer la qualité de vie des habitants de la ville, avec une haute performance à un faible coût.

1 INTRODUCTION

Bogotá is the Capital and most important city in Colombia. It has 6.4 million inhabitants, 15.2% of the nation total. Population growths 2.5% annually and most of its people are young adults: 62% of the total is between 15 and 54 years old. The city is 2,640 meters (8,500 feet) above the sea level, in the highest plateau of the Colombian Andes. The city covers an area of 1,737 Km2 (173,000 ha) and has a high density (3,717 inhabitants per Km2). Most of its urban area is flat, with some informal development in the hilly areas in the southern part of the city.

The local administration, with support from the National Government and private sector participation, is developing an ambitious mobility strategy to overcome its outstanding transportation problems, resulting from a very fast and disorganized population growth and a rapid increase in property and use of automobiles. The process started under the administration of Major Enrique Peñalosa (1998-2000) and was continued by Major Antanas Mockus (2001-2003).

Actions are aimed to promote non motorized transportation, to reduce automobile use and to give

priority to public transportation, and have been recognized as a sustainable approach with social justice (Stockholm Partnerships, 2002).

This report includes a short description of the TransMilenio Bus Rapid Transit System, specifying the scope of Phases I and Phase II, as well as the changes adopted between these stages.

2 THE TRANSMILENIO BRT SYSTEM

The TransMilenio bus rapid transit system was developed as a key element of the Mobility Strategy developed by Mayor Enrique Peñalosa. Its design seeks respect to life, diversity and travel time; with a high quality and consistent service, at an accessible cost for users.

TransMilenio system is a high capacity and low cost mass transit option (see Hidalgo 2002; Leriverend 2002). TransMilenio encompasses specialized infrastructure for bus rapid transit, an efficient privately provided operations scheme, a state-of-the-art fare collection system, and a new public company in charged of planning, developing and controlling the system.

Infrastructure, planning, developing and controlling the system are provided by public entities, while operations and fare collection are provided by private companies through concession contracts. Concession contracts are gross cost with risk sharing. Trunk line concessions are paid based on the kilometers run, while feeder line and fare collection contracts according to the number of passengers.

Several organizations have already reported TransMilenio as a sustainable mass transit option based on the results of its first phase, including the World Bank (2002), the International Energy Agency (Fulton, 2002), UN-Habitat (Development Planning Unit, 2002), the German Overseas Cooperation Agency –GTZ (Wright 2003), and the Transit Cooperative Research Program (Levinson et. al , 2003), among others.

The city envisions a 388 Km busway network for year 2020, covering 85% of the trips. One phase was completed and a second one is under implementation, for a total length of 81 Km (Figure 1). Information about the system is available at www.transmilenio.gov.co.

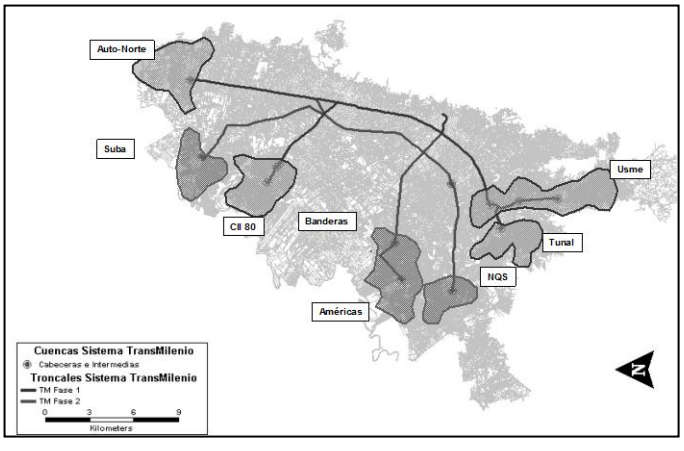

Figure 1. TransMilenio System Phases I and II
Source: TRANSMILENIO S.A.

3 TRANSMILENIO SYSTEM PHASE I

Phase I includes three trunk corridors covering 41 Km and seven feeder zones with routes covering 309 Km. The system has 4 terminal stations, 4 intermediate integration stations and 53 standard stations. Additionally, there are 27 pedestrian overpasses, plazas and sidewalks.

By May 2003, demand was 792,000 passengers/weekday using 470 articulated buses and 235 feeder buses. The system operates 18 hours per day, with 9 express services and 3 local services. Minimum headway was 2 minutes (peak) and maximum headway was 6 minutes (non-peak). In addition there were 45 feeder services with a minimum headway of 3 minutes (peak).

TransMilenio has a fare collection system that encompasses 90 selling booths, 359 barriers, and 1,300,000 intelligent contact-less cards, approximately. Daily revenue is around US$270,000.

Operations are managed by a control centre that is equipped with 6 workstations, each able to control 80 articulated buses. The system has voice and data permanent communication with all the articulated buses and system supervisors.

Each bus has a logic unit connected with a GPS, the odometer and the door opening system. The logic unit reports the location of the bus each 6 seconds with a 2 meter precision. The control operators have a monitoring screen for each service in schematic display and a digital map for physical location of the buses. The implemented software is able to verify schedule compliance, giving the controllers the opportunity to make demand and supply adjustments in real time.

For the first phase of the system, implementation took 48 months from system design to full operation.

Phase I reduced travel time by 38% for system users, fatal accidents by 93%, and some pollutants by 40%. The system is very well rated by its users, with acceptance levels above 78% (Hidalgo 2002).

Annual ridership was 23.5 million passengers during 2003. Total operational revenues were US$81 million; US$54 million (66%) was paid to trunk line operators, US$16 million (20%) to feeder bus operators, US$8 million (10%) to the fare collection concessionaire, US$3 million (4%) to the system administrator TRANSMILENIO S.A.

There are four trunk line concessionaries, five feeder zones contractors (seven zones), and one fare collection concessionaire in Phase I.

4 IMPLEMENTATION OF TRANSMILENIO SYSTEM PHASE II

The second phase is currently under implementation. Construction started in 2002 and initial operations in November 2003. It is expected to be completed by 2005.

4.1 Infrastructure

Phase II includes three corridors with a total length of 40 Km, with exclusive lanes for articulated buses. These corridors have the characteristics presented in Table 1.

There have been several enhancements in the contractual mechanisms and specifications of the infrastructure from Phase I to Phase II, in an effort to continuously improve the system's quality. The main improvements are presented in Table 2.

As a result of these enhancements, cost per kilometer has increased from US$5.1 million to US$7.5. Two corridors (NQS and Suba) also include financial costs, raising the cost to US$9.5 per kilometer. Infrastructure costs are covered with local revenues from a gasoline tax (25% surcharge), about US$70 million/year, and national grants, about US$100 million/year, from 2004 to 2016.

Construction of the new corridors started in the second semester 2002, and will gradually be commissioned starting November 2003 up to the first semester 2005.

Table 1. Characteristics of TransMilenio Phase II Corridors

	Americas	NQS	Suba
Length (Km)	13	20	10
Terminal Stations	1	1	1
Intermediate Stations	1	1	0
Standard Stations	16	21	13
Station Length (average m)	150	120	110
Pedestrian Overpasses	10	25	4
Total Width (m)	100	60	40
Busway Lanes	2	1 *	1 *
(width m)	(7)	(3.5)	(3.5)
General Traffic Lanes	5	4	2-3
(width m)	(17.5)	(14)	(7.0-10.5)
Sidewalks and bikeways (width m)	8	6	6
Median (width m)	20	10	3
Bus Interchanges	0	2	2
Passenger Interchanges	2	1	0
Bus facilities	1	2	1
Expected demand (passengers/day)	186.249	243.926	233.615
Commissioning	4th Quarter 2003	4th Quarter 2004	1st Quarter 2005
Cost (USD million)	117	466**	221**

* Passing lane at stations, additional 3.5 m

** NQS and Suba include financial cost, around 40%.

Source: TRANSMILENIO S.A.

The bidding process was similar to the one developed in Phase I (470 buses through 4 concession contracts). The rating system included points to local experience in traditional bus operations (fleet and routes), to financial capability, environmental performance, and requested payment per kilometer. Nevertheless, given that the system already showed its possibilities to the private sector, and there was a need for inclusion of displaced bus owners and to scrap more obsolete buses, some modifications to the first phase contracts were introduced:

- Responsibility to cover cleaning and safety of the new stations assigned to new trunk line operators
- More participation of the local authority in the system revenues
- Incentives to include owners of 1 or 2 buses as shareholders of the trunk line operator companies with a minimum of 10% of the shares (points were awarded to those that increase the offering, resulting in 21% owners participation and close to 4,000 shareholders).
- Requirement to scrap at least 6 obsolete buses to introduce each new articulated bus (points were awarded to those that increase the number of buses scrapped, resulting in a 7.1 new bus to old buses replacement ratio).

Table 2. Comparison of TransMilenio Phase I and Phase 2 Infrastructure Characteristics

	Phase I	Phase II
Design Horizon	20 year	10 year
Type of contract	Design-build	Build-maintain
Form of payment	Unitary costs	Fixed total cost*
Busway lanes per direction	1-2	1-2
General traffic lanes per direction	2-4	2-5
Pedestrian Areas and Bikeways	Not always included	Always included
Maintenance	Not included	5 year
Vehicle Interchanges	3 (simple)	5 (complex)
Passenger Interchanges	None	Two (using tunnels)
Pedestrian Overpasses and public space	27	39
Land acquisition (number of properties)	300	1200

* NQS and Suba include financial cost

Source: TRANSMILENIO S.A.

There were also some improvements in the bus specifications including weight sensors using the bus

suspension to prevent overload, electronic boards inside the buses for user information and electronic taco-graph, among others.

For the feeder zones several changes have been introduced in order to enhance the service provision and financial sustainability of the feeder operators. Contracts will be for 10 years, with fleet over 50 units, payment per kilometer, and enhanced electronic control. The bidding process was completed in December 2003. There are three new trunk line concession contracts (two of them with Phase I operators, and a third one with a new operator), and five new feeder zone contracts (two of them replacing Phase 1 contracts).

4.2 Ticketing

The ticketing system uses contact-less cards, which allow many sectors for different applications. Taking advantage of the opportunities provided by the technology, TRANSMILENIO S.A. decided to introduce a second operator of the fare collection system and went through a bidding process that ended up with the award of a new contract. This new contract has tightened performance controls and provides for mechanisms for integration with other applications (e-money). Integration among fare collectors is a challenge, but is technologically possible.

The new concession started operations with the system expansion in December 2003, and will be complete in the first semester 2005. Expected revenues are around US$200,000 daily; and the fare collector will receive 10% of these revenues to pay for the equipment and operations.

4.3 Control Systems

The control centre will be expanded with four workstations, each able to control 80 articulated buses. The system will continue with voice and data permanent communication with all the articulated buses and system supervisors. Additional controls will be provided for the feeder services.

5 CONCLUSION

A learning process has been applied for the TransMilenio BRT system expansion: better infrastructure with innovative financing mechanisms; more participation of the city administration in the system revenues with transfer of some responsibilities to private operators; inclusion of displaced bus owners; better environmental standards; new operators of trunk, feeder and fare collection systems, among others.

The process followed by the city of Bogotá for system expansion shows the importance of having a very clear strategic objective while keeping enough flexibility to learn and to improve implementation mechanisms. The provision of a high quality transit system at a low cost is a continuous process.

The expansion is expected to maintain high acceptance levels by the users and the population at large, and to increase the impressive reductions in travel time, accidents and pollution observed in Phase I (See Hidalgo 2002).

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