# *Bus Rapid Transit in Latin America*

*Jason Junge and Michael Groh*

*CE 5212*

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# INTRODUCTION

Bus Rapid Transit (BRT) has been used by a number of Latin American cities as a less capital-intensive alternative to rail. The earliest and most successful example was Curitiba, Brazil. Following that model, BRT has been implemented in a number of other cities, including Bogotá, Colombia, and Santiago, Chile, with varying degrees of success. BRT is characterized by segregated bus lanes, articulated buses, trunk and feeder routes, electronic fee payment, and contracted bus service.

# CURITIBA

***List of Actors***

- Urbanizacao de Curitiba SA (URBS) – company that manages bus line
- Instituto de Pequisa e Planejamento Urbano de Curitaba (IPPUC) – transportation research institute
- Bus Companies – paid to operate specific lines
- City Government – created initial transit plan
- Passengers

***Narrative***

The bus rapid transit system serving Curitiba, Brazil, is generally regarded as a successful model. Known officially as Rede Integrada de Transporte (RIT), it provides about 2 million trips per day in a metro area of about 2.2 million ("Curitiba"). About 75% of commuters in the area use the BRT system, and the system has an 89% approval rating (Friberg 2001). Many cities have attempted to replicate this success.

From the 1960s into the 1980s, the population of Curitiba was growing rapidly – at about 4% per year. The government faced a major struggle to supply adequate urban services to accommodate this growth. In 1964, Curitiba responded by creating what would become the Curitiba Master Plan. This plan aimed to promote transportation and development around five structural axes, preserve and decongest the city center, manage land use, provide incentives for certain urban development, and improve infrastructure. ("Curitiba")

In 1965 the Instituto de Pequisa e Planejamento Urbano de Curitiba (IPPUC) was formed to implement and monitor the Curitiba Master Plan (Campbell 2006). The IPPUC was a planning institute with genuine political support behind it (Campbell 2006). Throughout Curitiba's growth, this organization has been a key player ("Curitiba"). It was instrumental to the creation of the modern Curitiba BRT system through a series of incremental and pragmatic steps (Rabinovitch 1996).

***Operation***

The Curitiba BRT system is managed by Urbanizacao de Curitiba SA (URBS). URBS is a municipal company that controls services, fares, and profit. It contracts the necessary bus routes to sixteen different bus companies. Competition among the bus companies creates the best service and price for riders. The price, as of 2004, was fixed at approximately sixty US cents; and this price creates a significant profit. URBS divides the profit among the bus companies based on their km of service and their type of route. In 1996 the profit was as high as 11.4%. Operations are not subsidized. ("Curitiba")

Along its 60 km of specialized roadway, the Curitiba BRT system has a number of "Tube Stations" that function as bus stops. The stations are named for their unusual shape, but they also have useful functions. Tube Stations allow for at-height access to busses. They also save time because riders must pay to enter the station – thus, riders don't have to worry about paying while getting on the bus. (The Tube Stations are manned to prevent cheating.) In fact, Tube Stations are three times as efficient as regular bus stops, in terms of passengers per hour. ("Curitiba")

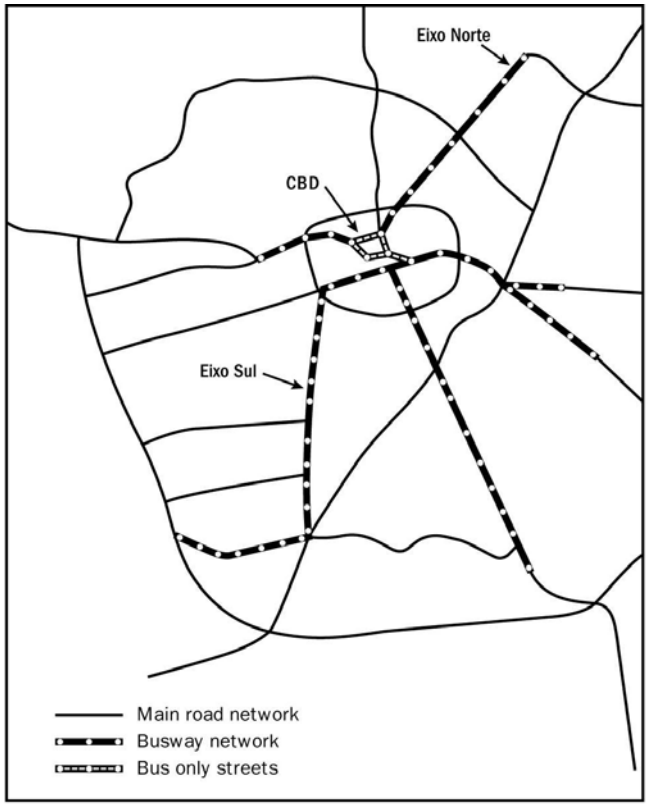


**Figure 1. Map of Curitiba BRT System.**
**[Source: "Curitiba"]**

Comparing the original goals of the Curitiba Master Plan with current conditions, it is clear that the key objectives have been met. Curitiba has met its goal of protecting its center city, as seen in Figure 1. The main roads in the Central Business District have become bus-only. In addition, a total of 49 blocks have become pedestrian-only to preserve the character of the district (Rabinovitch 1996).

Figure 1 also illustrates the five axial roads described in the Master Plan. These axes are not ordinary streets, but rather Trinary Busways. Trinary Busways consist of a two-lane bidirectional bus-only road in the center, flanked by two parallel one-way roads for local traffic (Friberg 2001). All together, these roads are about 85 ft wide ("Curitiba"). An illustration of a Trinary Busway can be seen in Figure 2. The five axial roads are very important as a way for people to travel straight across the city in a very short time. Because the buses are now isolated in their own lane, trips are much faster than they otherwise would be.

The bus routes that travel on the Trinary Busways are Express buses. They are the fastest routes in the city. Each of the five Express routes has a terminal at its end and its middle. The terminals allow passengers to interchange to or from feeder routes. As the name implies, Feeder routes connect less dense areas of the city with Express route terminals. There are 26 terminals in all, and these may also contain commercial development, such as stores or restaurants. ("Curitiba")

Direct bus routes operate parallel to the Trinary Busways, but one block to each side. These streets are one-way, so Direct bus routes are also quite efficient. Inter-district buses connect multiple neighborhoods. CBD buses serve the central business district, where no other vehicle traffic is allowed. Metro buses serve destinations in the metro area but beyond the city. Finally, Conventional buses fill in the remainder of the routes. ("Curitiba")

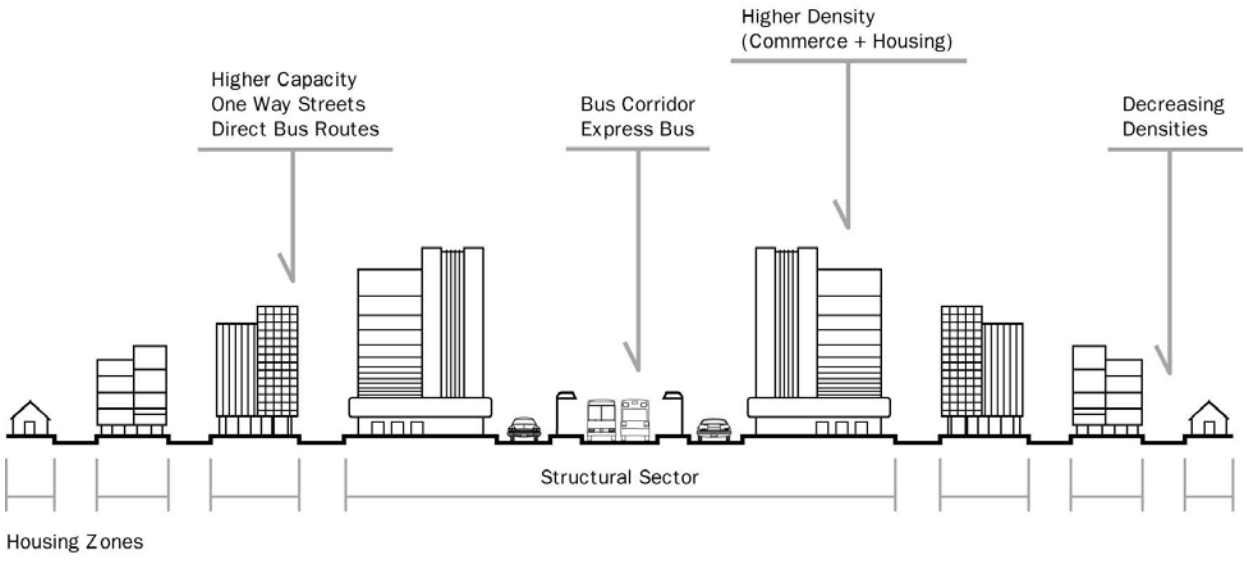


**Figure 2. Cross-sectional view of Trinary Bus Corridor and adjacent blocks. [Source: "Curitiba"]**

The decision to focus bus service along five axial corridors gives these locations greater importance to Curitiba. Figure 2 shows the ideal development density to match the Express and Direct rounds. It is desired that high density commercial or residential uses exist adjacent to the Express line so that people will have extra reason to use the bus system. Thus planners have attempted to influence land uses to integrate better with the transportation system. ("Curitiba")

This influence has been created with zoning restrictions and incentives. Making car use more difficult is another option: planners can restrict parking or simply prohibit cars on a road. These actions have been used to create greater demand for the BRT. ("Curitiba")

Since Curitiba's bus rapid transit developed in the 1960s, the IPPUC has led it through numerous advances. The Curitiba Master Plan was an unprecedented success. From there, the Tube Stations were added. Next, bi-articulated buses were added. Currently, the Tube Stations are being upgraded to use Smart Cards. Without the technical prowess of IPPUC, it is doubtful if these advances would be taking place. ("Curitiba")

The example of Curitiba is certainly a compelling one; however, caution should prevail when aspiring to recreate it. Most existing cities have established right of way and transportation infrastructure. To change it all to a trinary structure would be extremely costly. Even neglecting the trinary structure, it is difficult to give buses the level of priority they have in Curitiba. The integration between transportation and land use is also difficult to generate. Only in cities that are still developing is Curitiba a reasonable model to attempt to replicate.

***Timeline***

| | |
|---|---|
| 1965 | IPPUC established |
| 1966 | Curitiba Master Plan passed |
| 1978 | Fifth and final structural axis completed for Express busses |
| 1979 | Inter-District bus lines introduced |
| 1991 | Direct lines introduced with tube stations |
| 1992 | Bi-articulated buses introduced |

***Policy Issues***

- Specialization – eight types of lines are used, from express to CBD circulators
- Think tanks – the UPPUC has powerful ideas but is not part of government

- Privatization – the bus system is privately managed and bus lines are contracted

- Gradual Implementation – the system developed over several decades

***Discussion Questions***

1. Curitiba's transit system is generally considered very successful. How would you measure the success of a transit system?

2. Is it appropriate to use land use planning to drive the use of a transit system? Or should transit simply serve land uses?

# BOGOTÁ

***List of Actors***

- Ministry of Transport – federal transportation agency
- Secretariat of Transit and Transportation (STT) – municipal agency
- Transit Companies – owned rights to routes
- Bus Owners – paid rent to transit companies to operate buses
- Bus Drivers
- TransMilenio – BRT administrative agency
- Passengers

***Narrative***

The operation of the mass transit system in Bogotá has historically alternated between public and private interests. Beginning in the 19$^{th}$ century with privately-owned trolleys, it evolved into a public bus system and then transitioned back into private ownership. Inefficiencies and negative incentives developed within the institutional arrangement of the traditional bus system, leading to the introduction of a bus rapid transit (BRT) system in 2000. The BRT line, known as TransMilenio, is scheduled to replace the traditional system gradually and is expected to carry 80% of the city's transit trips by 2015 (Echeverry, et al 2005). TransMilenio currently carries approximately 20% of trips and has improved efficiency along the corridors in which it operates, but the old system remains intact across much of the city.

***Traditional Bus System***

The traditional arrangement includes three types of actors: government agencies, private bus companies, and bus owners (Ardila 2007). The federal government's Ministry of Transport determines the general procedures for Bogotá and other cities by regulation and through acts of Congress, including setting fares by a nationwide formula. STT is the municipal authority,

responsible for issuing permits-for-life to bus companies to operate specific routes within the city and setting schedules and frequencies. Bus companies own the rights to their operating routes but do not own the buses. Small private bus owners are legally required to affiliate with a bus company and pay rent to operate on that company's routes. This provides incentives for bus owners to compete against each other and operate their buses continuously, and for the bus companies to encourage as many buses as possible, leading to an oversupply of buses. Because the owners' revenue decreases as the number of buses increases, they convinced the Ministry of Transport to create a pricing scheme that automatically increases fares as the ridership per bus per unit time declines, effectively passing the cost of the inefficiency on to the user. The city government attempted to implement a fairer formula, but was blocked by the courts since only the Ministry of Transport has authority for such reforms. This demonstrates a correspondence problem, in that STT is expected to oversee the transit operations in Bogotá, but does not have the tools to do so.

***TransMilenio***

Recognizing these institutional barriers, the city council created TransMilenio SA as a single agency with both the responsibility and the means to administer a new system. As illustrated in Figure 3, the conflicting interests of the transit companies and bus operators are removed, and functional entities interact with each other more efficiently, under the supervision of TransMilenio SA. Segregated bus lanes were constructed in phases along several of the traditionally busiest bus corridors. Four new bus companies were selected by bid to operate the routes using articulated buses, as well as a feeder system using conventional buses. Criteria for selection included fare per kilometer, local experience, environmental effects of the equipment and financial backing (TransMilenio SA). Thus, one agency plans routes, frequencies and schedules, and the companies it deals with directly operate buses, not routes as under the

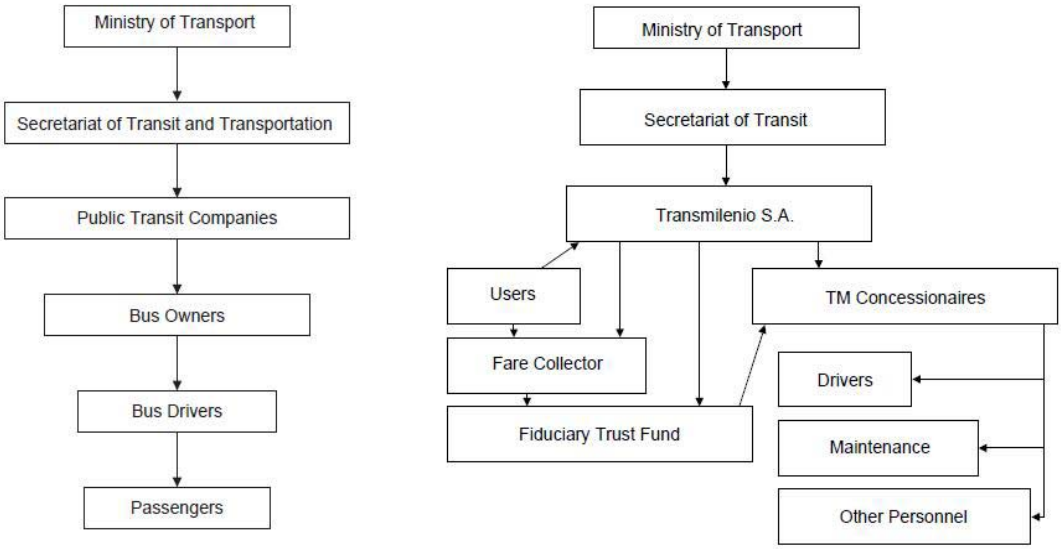


**Figure 3. Organization of the traditional model (L) and TransMilenio (R). [Source: Ardila 2007]**

traditional model. This leaves TransMilenio free to change routes and schedules as necessary, and removes the incentive for the bus companies to crowd the routes with buses, as the number is established by contract. The contracts have a specified duration, after which the terms can be renegotiated and during which new companies are prohibited from entering the system. Fares are set by TransMilenio SA based on total system costs, not the per-bus costs of the traditional model. Passengers pay when they enter the station as in a rail system. The fare collection process is electronic and prepaid, and administered by a private collection company. The collection company turns the fare over to a TransMilenio trust fund, which in turn pays the bus operating companies per kilometer rather than per passenger. This new system replaces competition between operators within the market to competition for the right to operate within the market.

The first two 41-kilometer phases of planned route construction are complete as shown in Figure 4, and their implementation has increased the average transit speed by 11.7 kilometers per hour (Cain, et al 2006). Phase 1 resulted in a 32% reduction in average travel time for transit users. TransMilenio is also significantly safer than the traditional system. Collisions on service corridors of the first two phases were reduced by 79%, and crime at stations is also lower. On the main lines, the platforms are at the same level as the bus, and a system of GPS units and electronic message boards gives passengers information on arrival times. Getting on and off the bus under the conventional model could be dangerous, as drivers sometimes try to race and block other buses, and only stop for a very short time wherever a prospective passenger awaits.

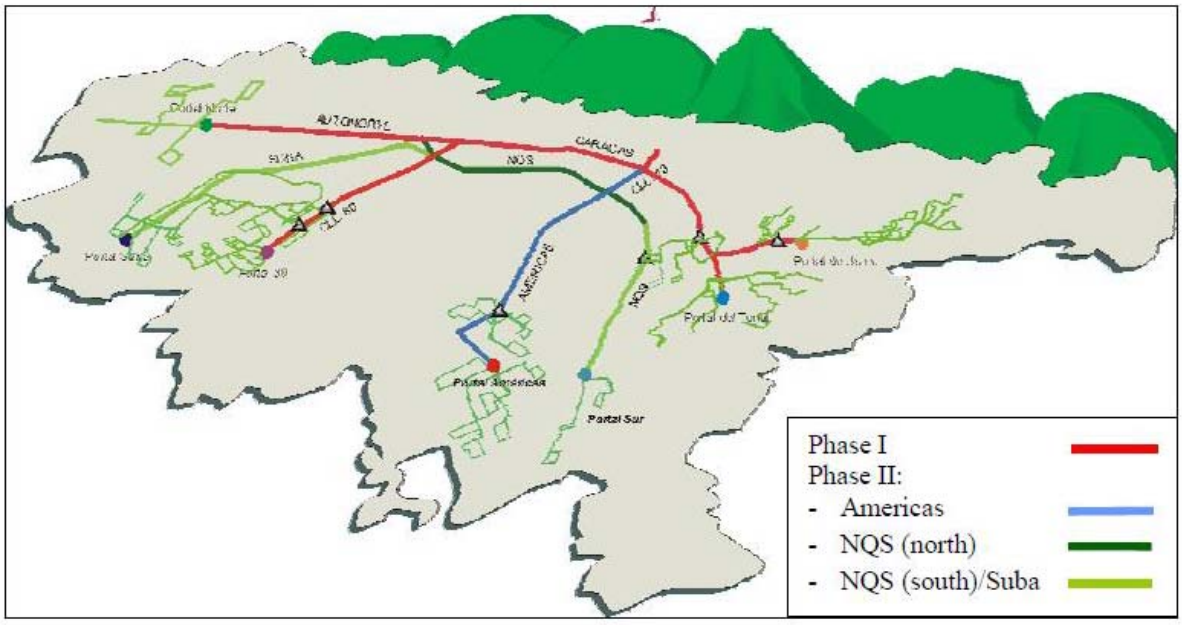


**Figure 4. Phase I and II trunk and feeder routes. [Source: Cain, et al 2006]**

TransMilenio and the traditional bus system are effectively competing modes. TransMilenio competes by offering a better service, but it cannot raise fares significantly higher than the other bus companies. Its fares are calculated to cover administrative and operating costs, and may not be sustainable at the current rate because any expansion would consist of less profitable routes (Ardila 2007). When the new service was introduced, demand for conventional buses dropped, but fares were still allowed to rise (Echeverry, et al 2005). Creating TransMilenio also required a political compromise including traditional operators, so that as old routes were replaced by new bus lanes, the bus owners were granted new routes to replace them, simply moving the congestion rather than eliminating it.

Because TransMilenio will not completely replace the traditional bus system for the foreseeable future, plans were included in the reform to address the shortcomings of the old model. Companies operating TransMilenio buses purchase and scrap a certain number of buses for each new bus they introduce; the ratio was 2.7 for Phase 1 and 5.5 for Phase 2 (Ardila 2007). This has had a lesser effect than intended because the Secretariat of Transit and Transportation is not sufficiently powerful to prevent the operators in the traditional model from replacing their buses, which they need to maximize revenue. Other attempted reforms included changing the fare structure to prevent fares from rising with the number of buses, and to make the transit companies responsible for collecting fares, rather than the bus owners. All would improve overall efficiency by removing incentives to oversupply buses, but are resisted by bus companies. Courts have declared the reforms illegal because they were enacted by a municipal agency but only the federal Ministry of Transport has that level of authority.

***Timeline***

| | |
|---|---|
| Before 1990 | Operation of traditional bus system; rail suggested/rejected several times |
| 1990 | Caracas Avenue Busway opens |
| 1992 | Caracas Avenue Busway extended 8km outward |
| 1994 | BRT proposed, but falls through due to lack of funding |
| 1998 | Rail proposal negotiated with national government; recession hits |
| 1999 | TransMilenio SA established |
| 2000-2002 | 41km Phase 1 opens in sections |
| 2003-2006 | 41km Phase 2 opens in sections |

***Policy Issues***

- Conflict between agencies – responsibility vs. authority, correspondence issues
- Safety – lack of regulation, buses in poor condition allowed to operate
- Contract negotiations – negative incentives

***Discussion Question***

1. How does the political environment in U.S. metro areas generally compare to that in Bogotá? Would it be any more conducive for the success of BRT?

# SANTIAGO

***List of Actors:***

- Private bus companies
- Transantiago agency – new agency to coordinate new system
- Metro agency – administration of existing rail line
- National government – initiated transportation system reforms
- Passengers

***Narrative***

Inspired by the success of BRT systems in the region, such as those in Curitiba and Bogotá, Santiago began a program to reform its entire public transportation system. The program, named Transantiago, was designed to address inefficiencies similar to those exhibited by the traditional model in Bogotá. Before 1979, a state agency was in charge of regulating fares, routes and the permits necessary to operate public transit in the city (Díaz, et al 2004), and service was scarce and of low quality. Rights of entry, routes and frequencies were deregulated in 1980, followed by fares in 1983. This resulted in a sharp increase in the number of buses, which improved coverage and frequency of service, but also caused fares to rise and exacerbated congestion and pollution problems. In 1991, the government purchased and retired 2600 buses and reintroduced regulations on fleet age, size and emissions. A process was also instituted whereby bus operators bid for the rights to operate certain routes, but because of political conflicts little reduction in coverage or frequency took place. Fares decreased at first, but after ineffective negotiations in 1998 began to return to deregulation levels. Díaz, et al, identify three main problems with the system prior to the introduction of Transantiago: excessive duplication of routes in the city center, poor condition of buses, and high accident rates. President Ricardo Lagos began planning reforms to address these deficiencies after taking office in 2000, and the process has continued under current president Michelle Bachelet.

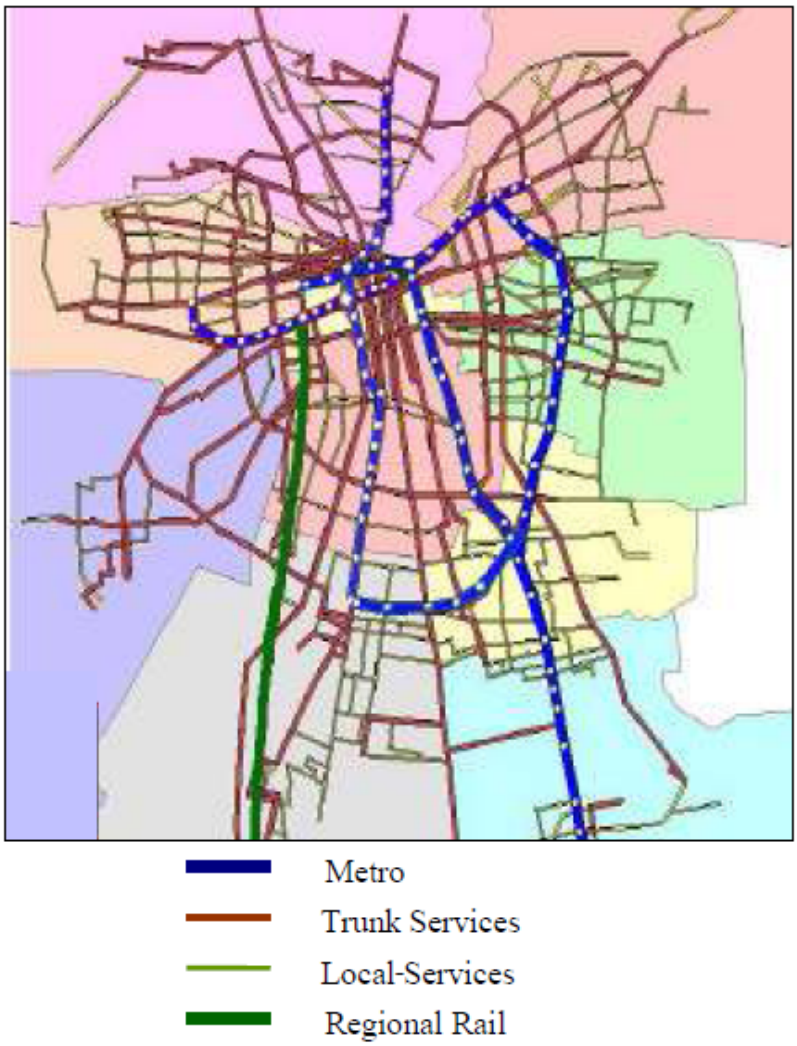


**Figure 5. Transantiago system map. [Source: Hidalgo and Graftieaux, 2007]**

***Planning***

Transantiago was planned to include improvements to the bus system, extension of the existing Metro line and integration of all transit services in the city (Hidalgo and Graftieaux, 2007). Bus routes would be reorganized into trunk routes along major thoroughfares with a feeder system to collect passengers from outlying areas, as shown in Figure 5. Segregated bus lanes were constructed along the trunk routes, and geometry and pavement improvements were included at several locations. Two intermodal stations and 70 bus stops were also constructed. An electronic fare system was developed for both the rail and bus systems, in which passengers buy prepaid contactless cards and validate them upon boarding. The system is administrated by contract, with each trunk route and feeder service area bid separately. Control, user information, and fare collection are also provided by concession. Bus companies are paid by Transantiago, and portions of fares also go to the financial and information system contractors and to an infrastructure fund.

Several difficulties arose in the planning process. The interests of Metro, a separate agency, did not necessarily coincide with those of bus companies. Transantiago was created as a new agency to coordinate competing interests and oversee the planning and operations. Metro enjoyed much better public perception than the bus system, so resources were dedicated to expanding rail service as a political compromise. The plan also faced opposition from leaders in the existing bus industry, who would not benefit from modification of the regulations already in place. They pushed for the bidding to be opened only to existing operators, but settled for a stipulation that allowed the use of existing vehicles.

***Implementation***

The new bus companies began operating on the old routes in 2005, and the Metro expansion has been constructed gradually, but all buses switched to new routes on the same day. Planners chose to make the change all at once to avoid managing two sets of regulations and to provide commuters across the city with the new service at the same time. The transition did not go smoothly, as service coverage was reduced, waiting times increased and trains and buses were overcrowded, resulting in protests and rioting (Hidalgo and Graftieaux, 2007). The fare collection card system did not function initially, resulting in free trunk services for the first week. A media campaign was launched to prepare the public for the change, but customer confusion was widespread as to how the system would operate, where the new routes were located and where to pay (Correa 2008).

The trunk-feeder network structure improved efficiency in bus operation, but increased the number of transfers needed and increased time spent walking. Because the system was opened before facilities were completed, there were fewer buses than needed and their operating speed was lower than designed. Moreover, new articulated buses were allowed to begin operating before geometric improvements were completed. Stations planned for major transfer points were incomplete, so all entrances and fare validations had to be accommodated by a single door, causing schedule delays. This caused the buses, and eventually the Metro trains, to become overcrowded. In 24 hours, Metro ridership doubled to 2.4 million because of passenger unfamiliarity with the new bus system (Correa 2008). Car use increased significantly as well, reintroducing congestion issues.

The major problem with the design was that planners did not consult adequately with the bus companies or with riders. The traditional routes had developed organically, as private operators could maximize profits by providing service to where large amounts of travelers wanted to go. In the new integrated system, bus routes were designed to end at Metro stops, in some cases requiring transfers from bus to train and then train to bus where before there had been a direct route. Routes parallel to the Metro line were eliminated, further adding to overcrowding on the trains. The planned central control for bus fleet management was never fully implemented.

There were also problems in the structure of the contracts, both for the operating companies and for the drivers. Drivers are paid by the hour, removing the competitive nature of the per-passenger scale but also prohibiting any type of pay for performance. Drivers thus have no

incentive to enforce fares or even to make all their scheduled stops. Enforcement of clauses in the operators' contracts providing for minimum frequencies and amounts of buses is weak.

The Bachelet government has introduced several measures to address specific faults in the Transantiago system (Hidalgo and Graftieaux, 2007). Changes included adding parallel bus routes along the Metro lines, extending routes to areas poorly served by the new system and constructing more dedicated and exclusive bus lanes. Bus company compliance with contractual terms has also been reemphasized. Many of these problems could have been observed on a smaller scale and corrected if Transantiago had been implemented gradually, as similar systems have been. The planning process could have gone more smoothly if there had been more continuity in leadership (Correa 2008) and routes would have been more effective if service on busy existing routes had been given priority over connecting with Metro.

***Timeline***

| | |
|---|---|
| Before 1979 | Regulation by state agency |
| 1980-1983 | Complete deregulation and privatization |
| 1991 | Reregulation of fleet size, age and emissions |
| 1998 | Failed negotiations with operators allow fares to rise |
| 2000 | Ricardo Lagos becomes president, planning for transit reform begins |
| 2005 | New buses and operating companies introduced |
| 2006 | Michelle Bachelet becomes president, planning continues |
| 2007 | Complete system switch on February 10 |
| | Bachelet announces changes March 10 |

***Policy Issues***

- Lack of communication with the public, in both planning and implementation
- Implementation of a large system all at once, before completion
- Conflicts between bus and rail interests
- Public vs. private financing and control

***Discussion Questions***

1. What are some advantages and disadvantages to changing the entire system at once?

2. Bus companies under the old model were able to turn a profit on a service that lacked quality in many ways. Should firms be allowed to profit by providing a public service? Should they have to reinvest profits into system improvements?

3. How could the agency have communicated better with the public, both to get input during planning and to spread information before the switch?

# CONCLUSION

Despite sharing a variety of BRT characteristics, these three cases have reached very different outcomes. This has to do with the politics and history of each region, as well as practical decisions regarding implementation. Curitiba's BRT effectively is an ideal model, Bogotá's is successful within its historical context, and Santiago's is attempting to recover from disastrous mistakes.

The three BRT systems were very similar from a technical perspective. All three use bus lanes segregated from the rest of traffic – a costly but necessary measure. They also use systems characterized by trunk and feeder routes. In Bogotá the feeders are conventional busses, and in Curitiba the trunk and feeder routes are only two of nine route types. All three systems use articulated or bi-articulated busses to increase passenger capacity. They all allow payment using an electronic card, and Curitiba and Bogotá both use at-height boarding.

From a business perspective, the three cases are also similar. They all employ a private corporation that manages and plans the transportation for the city. In Curitiba it was URBS, in Bogotá it was TransMilenio, and in Santiago it was Transantiago. These entities then contract out bus routes to private bus companies. Competition among private bus providers is an advantage provided by all of these systems. Bus companies are paid per km in Curitiba and Bogotá (although Curitiba also factors in the type of route), and Santiago, though drivers are paid per hour in Santiago. Pay based on time rather than service rewards poor service, but this is the least of Santiago's problems. All in all, the three BRT systems are extremely alike.

While there seems to be consensus on the aforementioned policies, implementation naturally has been very different. In Curitiba the system was gradually built over several decades, using a very pragmatic method and the expert advice of IPPUC. In Bogotá the system had to be created in gradual phases, to replace an existing bus system that had fundamental problems. In Santiago planners had to work around opposition from existing bus service and the Metro rail agency, and their risky decision to change all bus routes on the same day ultimately backfired.

The logical conclusion from these cases is that transit systems should be implemented gradually and fit the political and historical context in which they are being applied. As shown in Curitiba and Bogotá, the BRT system has the potential to serve citizens very effectively. However, to prevent conflicts communication must take place with the public as well as other agencies. If other cities continue the trend of using BRT, they would do well to not only consider core technical aspects, but also the context and process for implementation.

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