

### 5.3. EXISTING PUBLIC TRANSPORT CHARACTERISTICS

#### 5.3.1. CURRENT INSTITUTIONAL AND LEGAL FRAMEWORK

This section summarizes the current institutional and legal framework for the public transportation system. It compiles and analyzes the different Laws governing or affecting the Regulatory Bodies and Organizations involved in this project.

##### 1) *Legal System for Public Transportation*

The following Laws are related to public transportation:

- **Transporting Activity** (Article 6, Law 336 dated December 20, 1996): An organized group of operations to perform an organized movement of persons or things by transportation modes is authorized by the respective Authorities.
- **Municipal Road Transporting Activity** (Article 6, Decree 1787 dated August 3, 1990, amended by Decree 091 dated March 13, 1998): Municipal road transportation activity is defined as an organized group of operations whose function is to carry out the movement of persons in motor vehicles within the same municipality, metropolitan area or special district.
- **Operation Area** (Article 32, Decree 1787 dated August 3, 1990, amended by Decree 091 dated January 13, 1998): The territorial division established by a respective authority within which a company or vehicle is authorized to satisfy transportation demand.
- **Transportation Demand** (Article 32, Decree 1787 dated August 3, 1990, amended by Decree 091, dated January 13, 1998): The number of users to be moved is within a determined operation time.
- **Dispatch** (Article 32, Decree 1787 dated August 3, 1990, amended by Decree 091, dated January 13, 1998): The departure of a vehicle from a terminal station is in on authorized schedule.
- **Transportation Offer** (Article 32, Decree 1787 dated August 3, 1990, amended by Decree 091, dated January 13, 1998): the transportation capacity is available in accordance with service level required in a determined operation time.
- **Operator / Transportation Company** (Article 10, Law 336, dated December 20, 1996): A transportation company as a unit of economic activity with its equipment and facilities suitable to perform the movement of persons or things.
- **Route** (Article 3, Number 5, Paragraph 1, Law 105 dated December 30, 1993): Public transportation service is carried out on route between an origin and destination, with some characteristics such as schedules, frequencies and other operational aspects.

##### 2) *Public Transportation Governing Principles (Law 105, Decree 336, 1996)*

Public transportation industry is governed by the following principles:

- Public transportation is a public service.

The State must guarantee an efficient performance of this service to all inhabitants. The legal system for this activity must be established by the Law. This activity may be performed directly or indirectly by the State.

### **3) Authorization to operate**

Based on Law 105/93, for the providing of transportation service, it is necessary to enter into concession. According to Article of Law 105,1993, the performing of public transportation service such as bus route operation, dispatch frequencies, operation areas, transportation special services such as school and tourism buses, will be subject to the qualification and the issuing of a concession.

Decree 1787, Law 105/93 and 336,1996 provides the following: private company/ association is subject to the authorized qualification for operation and then, the issuance and entering into an agreement to operate in a determined area, route, schedule or dispatch frequency. The following authorization is issued by the Administration upon request.

- Dispatch frequencies and routes and/or operation areas reserved in favor of the applicant for an 8 months term.
- The vehicles needed to cover the routes reserved, the type of vehicle, level of service.

However, this authorization does not provide operation license which is a recognition to provide public transportation service, issued by a competent authority with a ten years term. The Administration may cancel a license at any time after verifying any failure in meeting the requirements, which would prohibit the company from continuing to perform public transportation services.

### **4) Rate Establishment**

Based on new regulation, the Ministry of Transportation (MOT) is in charge of the policies and criteria in the free establishment of rates by each transportation means. The Capital District prepares a study on public transport costs which may be used as the basis for the establishment of new rates. The rate increment may not be higher than the inflation goals established by the Board of Directors of the Central Bank. In this way, the technical calculation of the rates will be in accordance with cost structure, limited by the National Administration policies.

The MOT suggested that within possibilities offered in Bogota, an additional rate increment was suggested at executive service levels for small bus type taking into account quality improvement criteria.

### **5) Assignment of Routes**

In accordance with the new jurisdictional system, the assignment of bus routes is made taking into account two essential factors: territorial autonomy and rationality. Local government may not authorize regular bus service outside the territory under their jurisdiction. The route assignment shall be based on existing or potential transportation demand.

Law 105/93 establishes that in case of the Special District and its neighbor municipalities, public transportation shall be organized by both municipalities. A common agreement for route and its frequency shall be reached, allowing a bus coming from surrounding municipalities to enter the central areas using main roads prepared for bus transportation.

### **6) Obligation of Secretariat of Transit and Transportation (STT)**

In the city of Bogota, the only transportation and transit authority is the Secretariat of transit and transportation (STT), which is part of the central sector in District administrative structure. Its main duties are the following:

- To assure the correct use and good operation of road system for vehicle and people movement in the District.
- To coordinate the activities and actions of the different organizations related to the transit, transportation and road sector in the District.
- To support and guide the development and organization of public transportation service in the District.
- To monitor the observance of the public transit and transportation regulation.
- To assume the regulatory and control responsibilities transferred to the District by the National Government related to roads, transit and transportation.

Finally, the police are competent to monitor the observance of transit and transportation regulatory system, persons and traffic safety on roads.

### 5.3.2. PUBLIC TRANSPORT ORGANIZATION

#### (1) Organization

Figure 5.3-1 shows the public transport organization in Bogota. The Secretariat of Transit and Transportation (STT) is commissioned with regulation, disposition and control of the service provision. The transportation company receives operating licenses from the STT by routes and roads. The companies are the only ones legally authorized to provide public transportation services. The company is devoted to operate buses from bus owners in an autonomous way. Bus owners who own buses register their buses to the companies to operate the buses on bus routes.

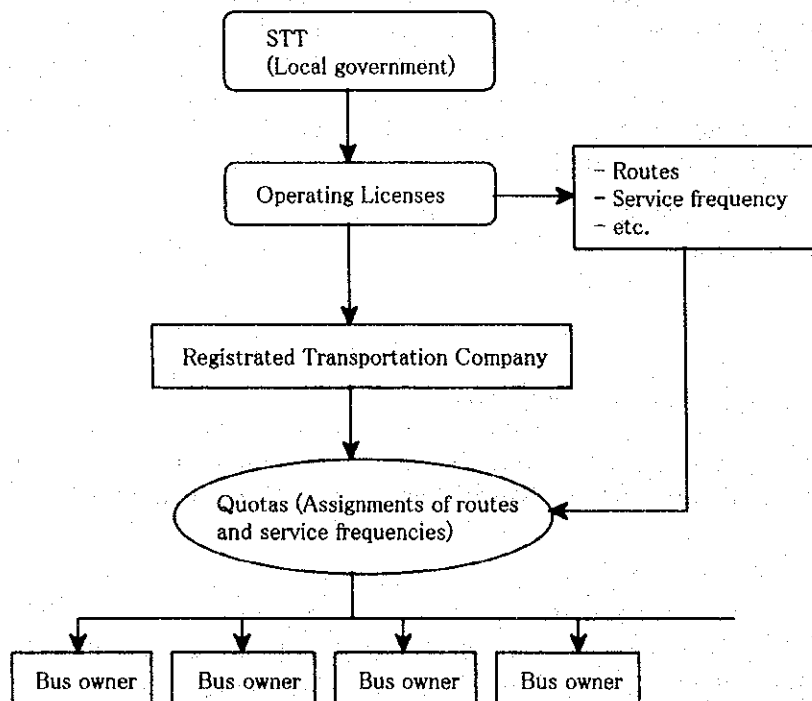


Figure 5.3-1 Public Transport Organization in Bogota

## (2) Transportation Company

The public transportation companies are authorized to operate under the following modalities:

- Owner of buses
- Self-administrator who has to be owner of at least 10% by law in 1997
- To affiliate with the cooperation (transportation unions)

Each company operates buses according to the routes and service frequency licensed by STT. This is called "quota system". The company has an operation quota. By law in 1997, the company has to own at least 10% of the buses of total operating buses which are included for company's owned and private owned buses (bus owners).

Presently, there are 68 bus companies authorized for public transportation in Bogota. Figure 5.3-2 shows the number of bus companies by buses owned which are included for company's owned buses and the registered quota buses owned by bus owners. As can be seen, ratio of number of companies which own 100 or fewer buses to the total is approximately 35% (25 companies), in contrast to 30% for companies with 500 buses or more. According to the figure, one third of the companies are of small scale in terms of owned buses. Especially, approximately 10% of companies having fewer than 30 vehicles.

What is important for the company, is bus operation. The company permits operation to the contracted bus owners on a route in proportion to the registered quota by receiving a commission. The actual operators are individual bus owners.

The income of the companies depends on mainly on the number of affiliated buses and not on the profitability from the operation.

The main transportation unions in Bogota with which the company has to affiliate are as follows:

- Conaltur: about 60% of total companies
- Asonatrac: about 10 companies
- Asotur: about 16 companies
- Fecoltran: about 15 companies
- Apetrans: union of small property

## (3) Bus Owners

The bus owners are distributed from a great majority of one-bus owners to a minority of owners who own a larger number of buses. The bus owners contract with the bus company and operate their buses. The bus owners are the principal administrators because the owners provide a daily bus service and take an operation profit. The bus owner decides on bus types to purchase, company to affiliate, route to operate, and contract of drivers. The bus owners of twenty three (23) % drive buses by themselves with old fleets. These are "owner-operator". These correspond to the most primitive.

The profitability depends on the service level. The service level decreases when profitability falls, and improves when profitability rises. When the profitability falls, route breaks over-saturation of passengers, or unauthorized routes are also usual. This is because the companies are difficult to control over the operation of their affiliated buses.

The owner-operators or owners accomplish an individual management of their buses that depends on their own capacities. Therefore, coordination with other operators is limited to service frequencies and schedules. They do not have public financial support.

#### (4) Bus Drivers

Bus drivers are hired individually by the operators. The drivers are paid a percentage from proceeds from passengers transported. Therefore, they prefer to operate on routes where they can obtain more passengers.

In case of buses and busetas, the owners select the drivers through verbal contract in which income depends on the number of passengers transported. The driver is also responsible for the cleanliness, basic maintenance of buses, etc.

The legislation requires drivers to have labor contract with a company. Driver payment involves two components: the variable salary which depends on the number of passengers and the basic salary. The basic salary is paid on the legal minimum for effects of the social security fund.

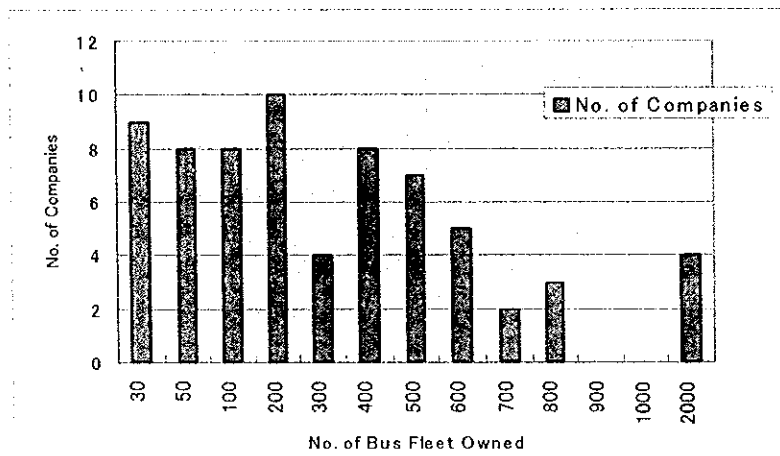


Figure 5.3-2 Number of Bus Companies by Buses Owned

#### (5) Bus Fleet

##### 1) Number of Bus Fleet

Type of bus fleet operated in Bogota is mainly classified into three: Bus, Buseta and Microbus. The definition of type of bus is shown in Table 5.3-1 which is defined by capacity and wheel base of buses.

Table 5.3-1 Definition of Type of Bus

Type of Buses	Capacity (persons)	Wheel Base (meters)
Microbus	10 - 19	$\leq 3$
Buseta *)	25 - 29	3 - 4
Bus	> 30	$\geq 4$

\*) Unlimited for seats, except length of wheel base

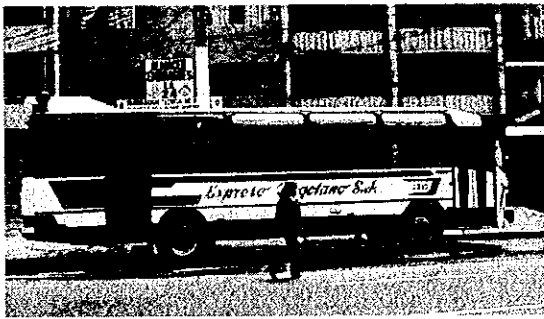
The number of present registered bus fleet is approximately 21,700 buses, of which approximately 10,000 vehicles are shared by Bus, 8,000 vehicles are for Buseta, the balance is for Microbus (see Table 5.3-2). One half of the vehicles are buses.

Bus slightly changes in size during last two decades for the proliferation of bus with safety risk and effects on traffic congestion. Microbuses increase year by year, while

Buses and Busetas decrease in recent years. Buses become increasingly small size for the advantage of maneuverability, speed and occupation level of bus no matter what the greater operation costs. Typical buses used in Bogota are shown in Plate 5.3-1.

Table 5.3-2 Number of Registered Bus Fleet

Year	Bus				Buseta			Microbus	Total
	Corriente	Ejecutivo	Super Ejectivo	Alterno	Corriente	Ejectiva	Super Ejectiva		
1994	9,188	1,919	31	39	871	5,813	90	3,789	21,740
1995	9,167	1,932	33	38	547	6,447	220	4,095	22,479
1996	7,769	1,908	37	35	191	6,764	472	4,308	21,484
1997	7,862	1,903	34	32	200	6,823	589	4,237	21,680



Bus Efectivo



Buseta Efectiva



Microbus



Buseta Corriente

Plate 5.3-1 Typical Buses used in Bogota

Figure 5.3-3 shows the distribution of model years of bus fleet. The figure illustrates the bus model years every 5 – 6 year depending on data available. As can be seen, Bus fleet is mostly registered in the end of 1970s and 1980s. Most of the registrations of Buseta are in the middle of 1980s, while Microbuses registrations are mostly in the middle of 1990s.

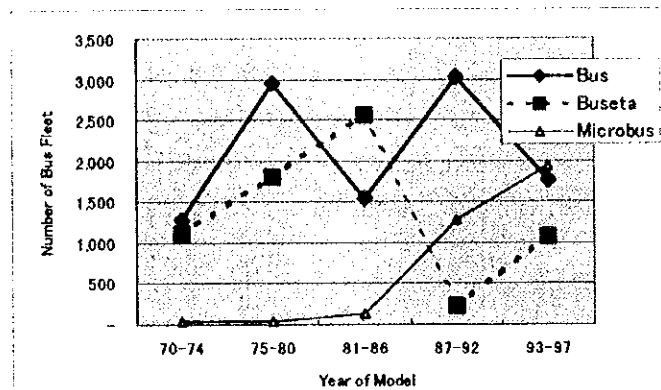


Figure 5.3-3 Model Years of Bus Fleet

## 2) Production of Bus Fleet

Bus fleet operated in Bogota is produced in Colombia, exclusive of some parts which are imported from America, Europe, Japan and South Korea. Main parts of bus fleet components such as engines, transmissions and axles are imported, while bus body, upholstery and others are produced in Colombia. In the factory, those parts are assembled into a bus. Table 5.3-3 shows contents of imported or Colombian products for buses. As for the category of body and others, the government restricts the use of imported products under the law, which are limited to 15% or less of total components.

Table 5.3-3 Contents of Imported or Colombian Products for Bus

Parts	Import or Colombian Products
Engine	Imported
Transmission	
Axle	
Body and Others	15% or More of total component are Colombian Products <sup>*)</sup>
Upholstery	

<sup>\*)</sup>: 35% or more for Automobile

Table 5.3-4 shows the cost of typical bus assembled in Colombia. The prices of buses are approximately 83 million pesos for Bus, 62.5 million for Buseta and 48 million for Microbus. As for the cost of parts for buses, the portion for bus chassis which mainly imported is significant and it ranges from 52 to 60% of the total. One half of the bus costs is composed of imported products.

Table 5.3-4 Cost of Typical Bus Assembled in Colombia

Type of Bus	Parts	Cost (1000 \$ Pesos)	Ratio of Cost
Microbus	Chassis	25,000	0.521
	Body	18,000	0.375
	Upholstery	5,000	0.104
	Total	48,000	1.000
Buseta	Chassis	34,500	0.552
	Body	23,000	0.368
	Upholstery	5,000	0.080
	Total	62,500	1.000
Bus	Chassis	50,000	0.602
	Body	28,000	0.337
	Upholstery	5,000	0.060
	Total	83,000	1.000
Super Ejectivo	Chassis	60,000	0.600
	Body	35,000	0.350
	Upholstery	5,000	0.050
	Total	100,000	1.000

Table 5.3-5 shows the production of buses assembled in Colombia and imported buses. The number of domestically produced buses has been considerably constant at an average of 1600 vehicles since 1992. As for imported buses, the figures vary yearly. The average number of imported buses is approximately 1200 vehicles since 1992. Approximately 60% of the total figures are assembled locally.

Table 5.3-5 Buses Assembled in Colombia and of Imported Buses

Items	1991	1992	1993	1994	1995	1996	Total
1) No. of Buses Assembled in Colombia							
Bus	103	1,182	1,196	649	502	316	3,948
Buseta	0	141	614	655	1,363	1,429	4,202
Total	103	1,323	1,810	1,304	1,865	1,745	8,150
2) No. of Imported Buses							
Bus and Buseta	0	589	808	2,315	1,935	246	5,893
3) Total No. of Buses							
Bus and Buseta	103	1,912	2,618	3,619	3,800	1,991	14,043
Ratio of Assembled	100.0%	69.2%	69.1%	36.0%	49.1%	87.6%	58.0%

Source: Statistical Year Book

### 5.3.3. BUS COMPANY SURVEY

In order to investigate the conditions of bus companies and bus drivers, approximately 30% of bus companies operating in Bogota were surveyed in the bus company survey. Company was selected from among large, medium and small scale companies to collect information and opinions according to the size of the activity.

The survey items are composed of number of employees, vehicles owned by the type (bus, buseta and microbus), type of service (super ejectivo, ejectivo, corriente, colectivo) and bus fleet age. Besides these basic company data, opinions about bus operation, tariff



system, trunk bus system, public bus terminal and suggestion about bus system in Bogota were interviewed. Bus drivers were also interviewed in the bus company survey to investigate driver's working conditions. The information such as bus routes, working hours, sales, income and a commission fee to a company was collected.

### (1) Characteristics of Bus Company

The surveyed bus companies vary in size such as employees and owned vehicles. Figure 5.3-4 shows the number of employees by bus company. The employees include office worker and driver. The share of companies with an employee of 50 –100 accounts for approximately 40% of the total. Approximately 20% of the total companies are big company in which 100 or more employees work.

Figure 5.3-5 shows the number of owned buses by the company. As can be seen, the companies which own 250-750 buses are predominant and its percentages are approximately 55% of the total.

Figure 5.3-6 shows the number of bus routes operated by bus company. As can be seen, the companies, which operate 10-15 bus routes, are predominant and its percentages are approximately 40% of the total.

### (2) Opinion of Bus company

In the bus company opinion survey, opinions about bus operation, tariff system, trunk bus system, public bus terminal and suggestion about bus system in Bogota were collected.

Almost all the bus companies are not satisfied with the current fare rate and they desire an increment of fare rate. Some companies also feel that technical survey is necessary for this matter. Some companies state that fare increment is possible only if stricter controls of illegal operators and buses coming in from outside the city are realized. These unauthorized transport operators severely damage operation and management of authorized public transport operators.

Approximately 70% of the companies replied that they agree with zone fare system in which the fare rises according to trip length. However, they also concerned that this system is difficult in actual application, especially ticket sale, fare collection and ticket validation. It is difficult to verify the ticket under the zone fare system without any fare collection equipment.

As for the trunk bus system, in spite of that 85% of companies agree the system, they also concerned whether their rights in this new system retain.

Nineteen (19) out of 20 companies said that the construction of public bus terminals would benefit their bus operation. 63% of those who said 'yes', also agreed to pay minimum operational charge of such facilities.

### (3) Suggestions for Public Transport Operation

Each public transport company has their own view for public transport system based on their experience as an operator. Their views and suggestions to bus operation system are summarized into 4 main groups.

- 1) Strict control and regulation of irregular routes and buses coming in from the peripheral cities.
- 2) Making change to public transport industry with due cooperation of authority and stakeholders. Those small and weak companies especially need special attention.
- 3) Improving efficiency of operation and reducing operation costs by construction of bus lanes and/or good maintenance of ordinary roads.

- 4) Introduction of intelligent card to control proceeds and modernization of public transport industry.

**(4) Bus Driver Working Conditions**

In the bus driver interview survey, approximately 30 bus drivers were interview, who belong 7 bus companies. The information such as bus routes, working hours, sales, income and a commission fee to a company is collected.

One round trip hours on their assigned route are an average 3.4 hours. The ratio of round trip hour with 4 or more hours to the total is approximately 10%. 85% of the drivers answered that the length of the assigned routes was sufficient, only 11% replied that it is too long.

The average driver working hour per day is approximately 14 hours, and working hour per week is approximately 90 hours of which 90 or more hours are for bus and buseta's drivers, and 60 hours are for microbuses.

Driver's sales per weekday varies from 25,000 to 100,000 or more \$pesos per week as shown in Figure 5.3-7. It is obvious that these sales vary widely depending on assigned bus routes. Figure 5.3-8 shows the distribution for monthly income of drivers. Their monthly income varies from 350,000 to 800,000 \$pesos per month. The drivers have to pay a commission fee from proceeds of bus sales. Approximately 60% of drivers pay a commission fee of 50,000- 80,000 \$pesos which is equivalent to 10-20% of the monthly income.

Approximately 85% of bus drivers feel that traffic congestion affects their job, and that there are too many public buses operated in Bogota.

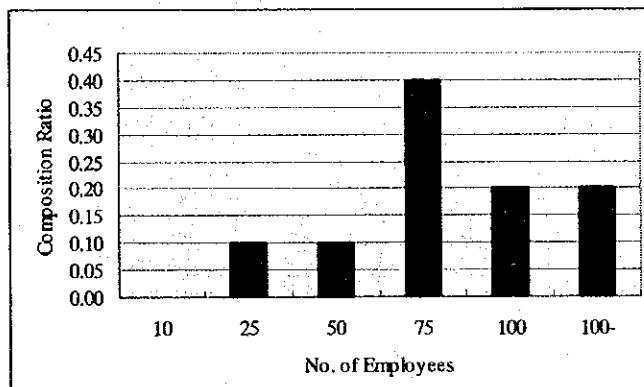


Figure 5.3-4 Distribution of Employees by Bus Company

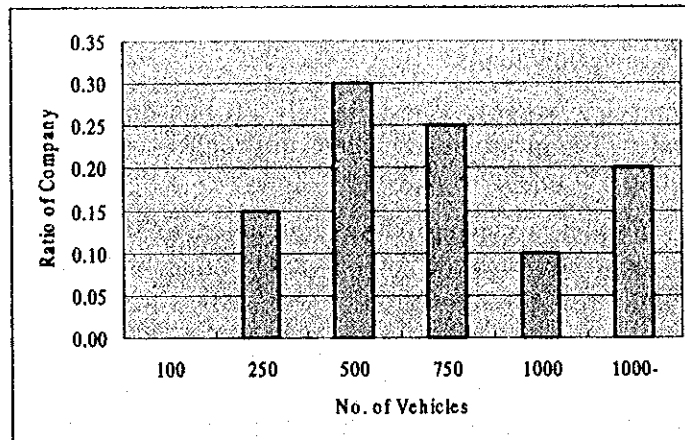


Figure 5.3-5 Distribution of Buses Owned by Bus Company

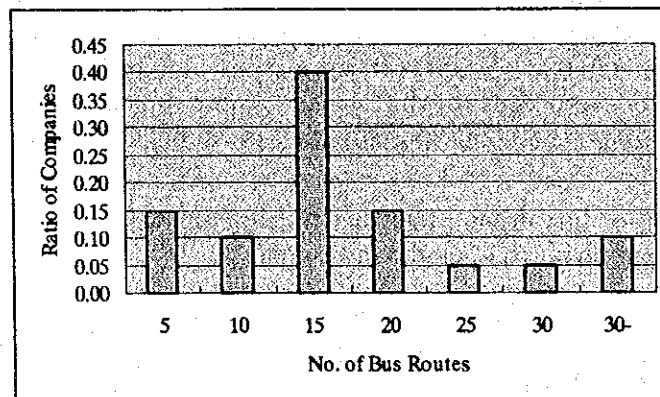


Figure 5.3-6 Distribution of Bus Routes Operated by Bus Company

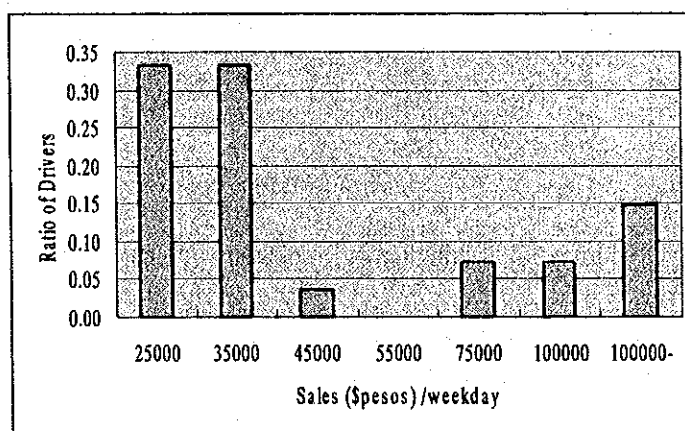


Figure 5.3-7 Distribution of Driver's Sales / Weekday

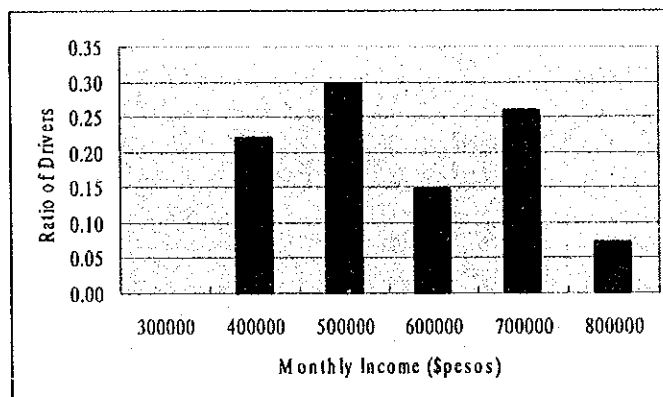


Figure 5.3-8 Distribution of Driver's Monthly Income

#### 5.3.4. OPERATION

##### (1) Bus Lines and Service Frequencies

On the current bus system, there are approximately 860 bus lines including illegal operation on unauthorized lines. In the Master Plan study, problems for those bus lines are identified. Among them, it is indicated that too many bus lines concentrate on some major roads. Figure 5.3-12 shows number of bus lines on roads. In this figure, the number of lines is drawn by a line whose width is proportional to the number of lines. As can be seen, maximum number of lines are on Av. 10 and Av. Caracas, followed by Av. Quito, Av. 68, Calle 80, Av. Suba, Autopista Norte, Av. Americas, Autopista Sur. On those roads, high composition rates of bus are recorded by the traffic count survey.

Figure 5.3-9 shows the relationship between number of bus line and its frequencies. As can be seen, number of routes (bus lines) with daily bus operation frequency in range of 40 to 100 lines are approximately 100 or more. In Bogota, the bus lines (number of routes) with frequency of 60 - 80 are predominant, while a bus service frequency of 200 or more is very rare.

Bus lines with highest rank of bus frequency are shown in Figure 5.3-13. The highest frequency is operated in line No. RC61-3 on Av. Mayo- Av. Boyaca- Centenario. The figure is approximately 400 per day. The second is in line No. RC135-1 on Calle 80 - Av. Caracas - Calle 13 - Av. Americas at 353 per day. Those figures estimated in the peak hour are about 30 - 40 frequencies/hr which are equivalent to 1.5 - 2 minutes.

Origin and destination of those lines are located in the residential areas near fringe of Bogota and in the central commercial areas, respectively.

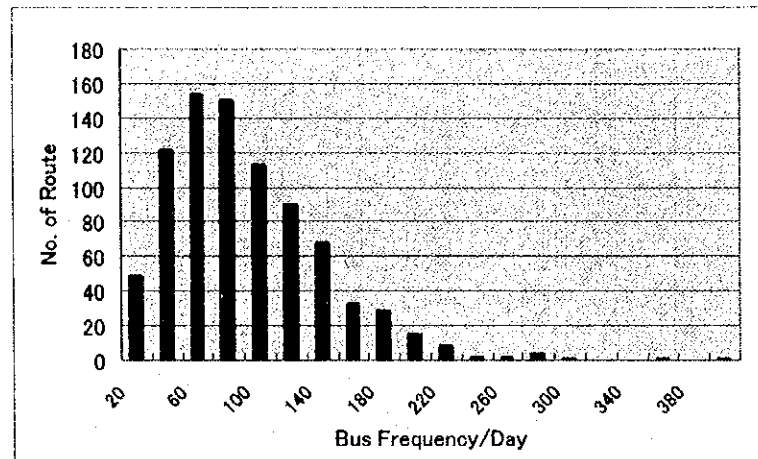


Figure 5.3-9 Relationship between Number of Lines and Its Frequency

Figure 5.3-10 shows the distribution of bus route service distance. The average distance is approximately 25 km. The route distance is distributed between 15 km and 35 km, of which approximately 270 routes are routes with a distance of 20-25 km and 240 routes are for a distance of 25-30 km. The total number of routes ranging from 20 to 30 km is 510 routes which is equivalent to 60 % of the total routes. The average route distance is equivalent to the distance from south to north of Bogota. On the other hand, the major travel distances of bus passengers from Person Trip survey data range between 3 and 15 km (see Figure 5.3-11). The average travel distance is approximately 9 km. From comparing the route distance to the bus passenger's travel distance, it is disclosed that the bus route distance is too long in relation to the travel distance.

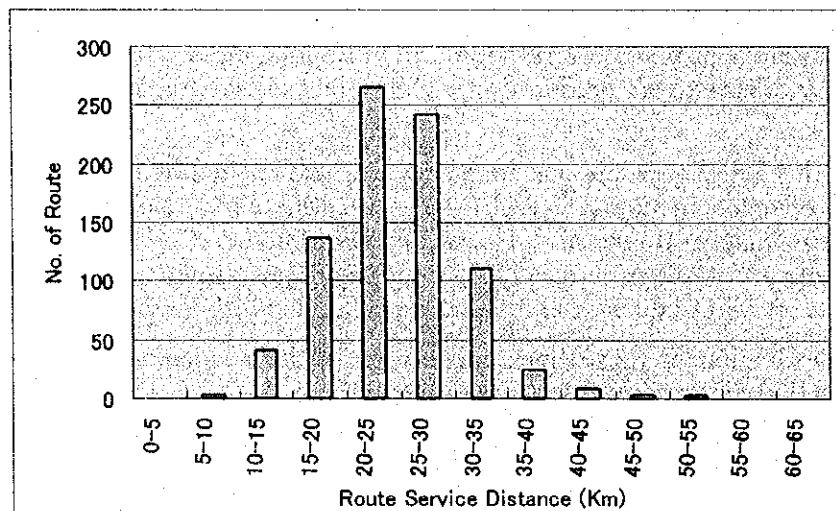


Figure 5.3-10 Distribution of Route Service Distance

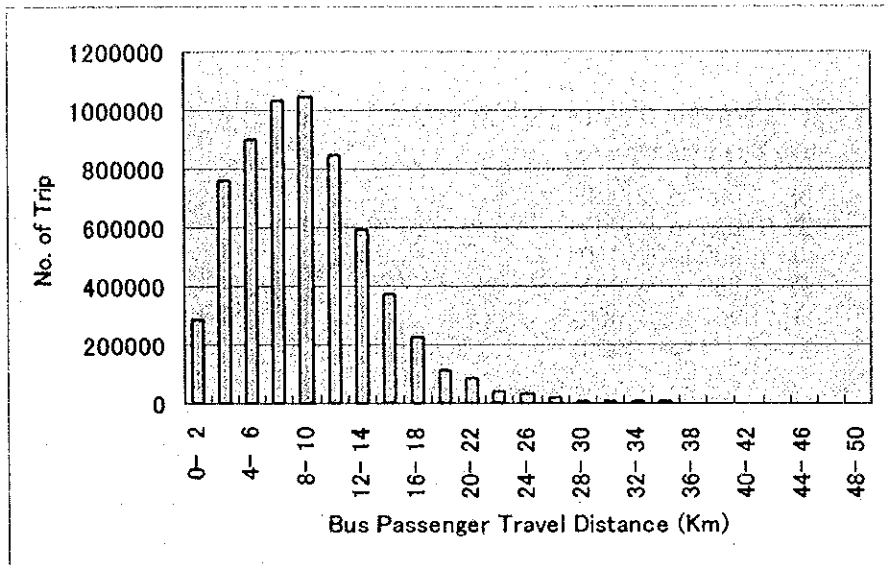


Figure 5.3-11 Distribution of Travel Distance for Bus Passenger

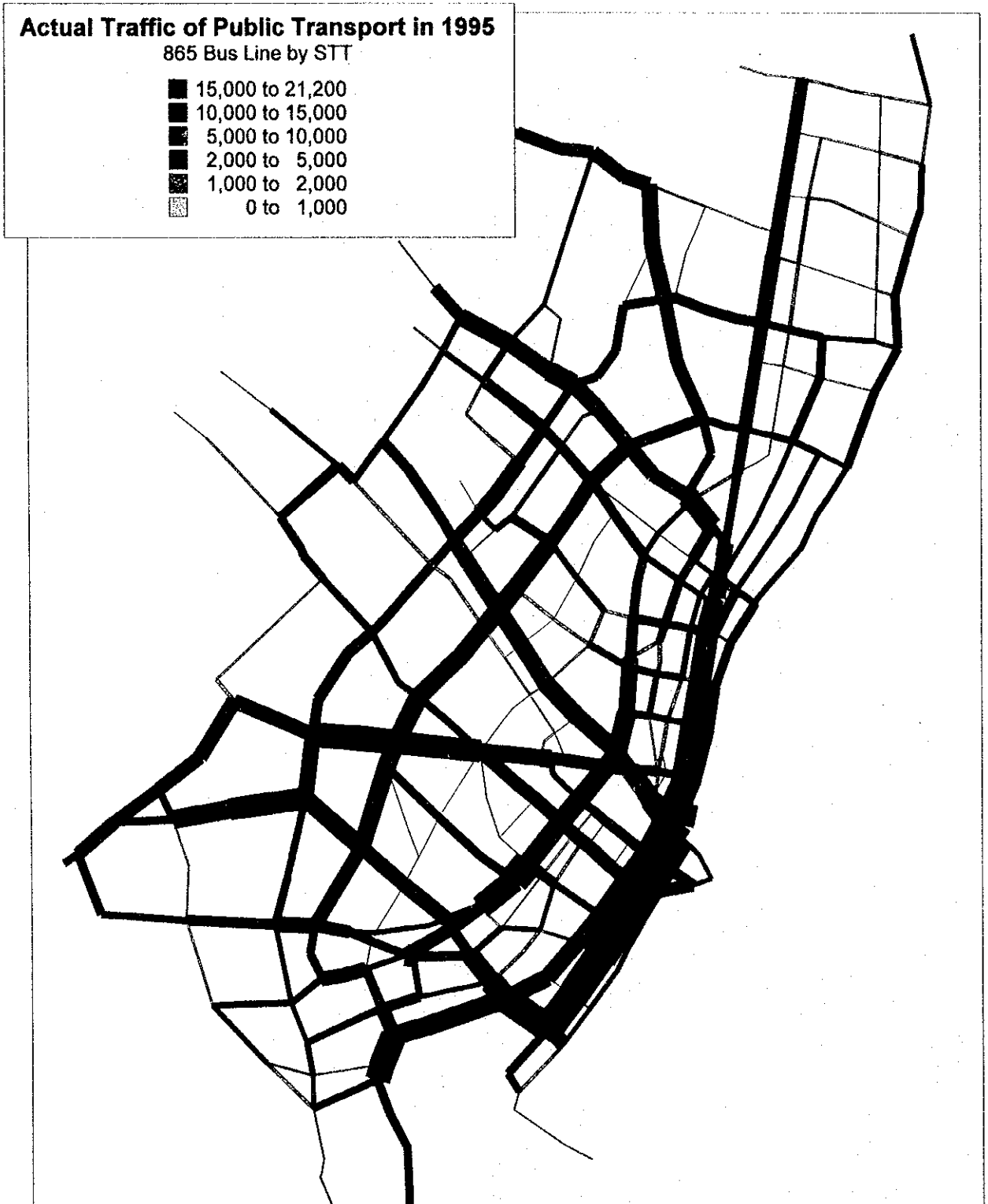


Figure 5.3-12 Numbers of Bus Lines on Roads

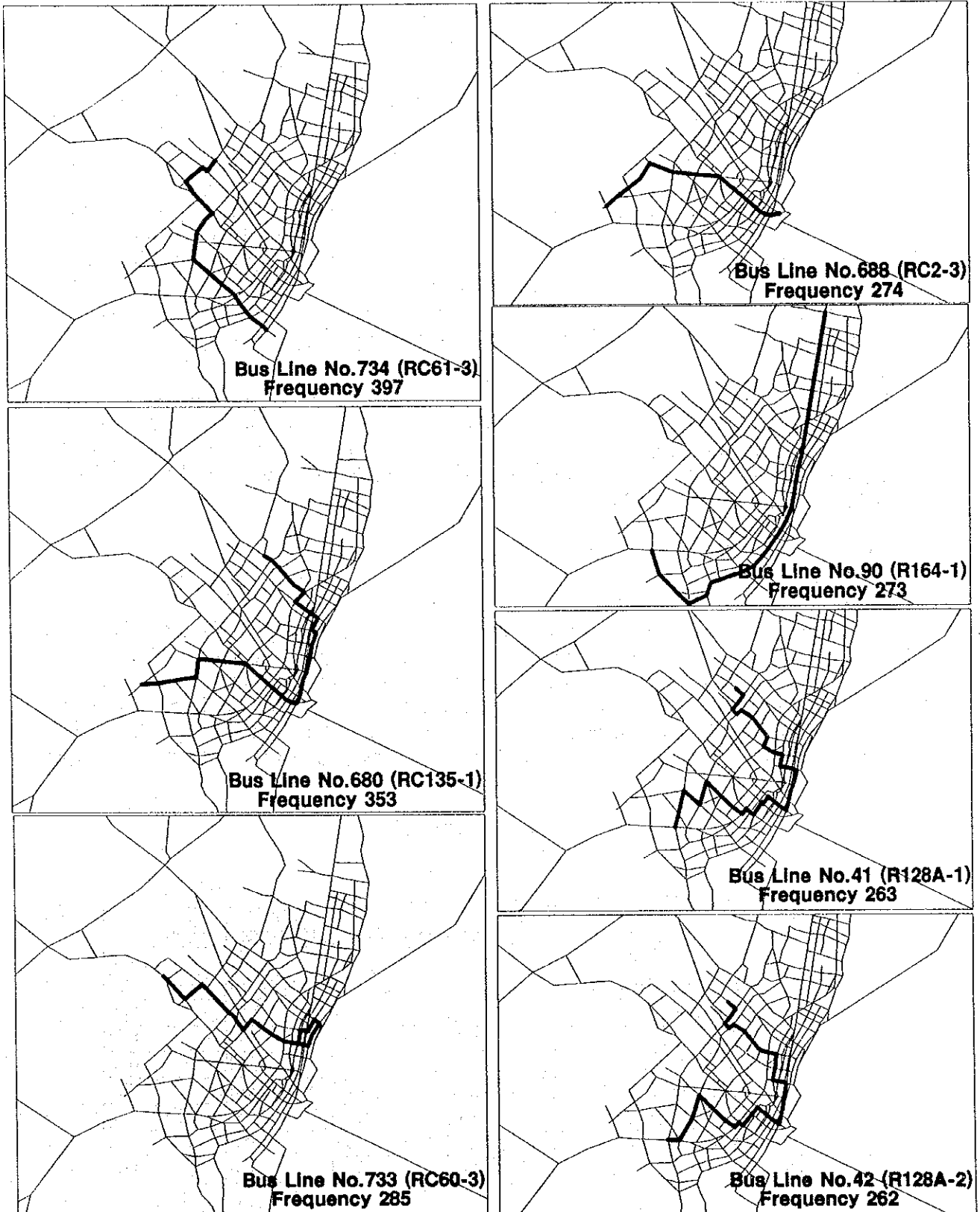


Figure 5.3-13 Selected Best 7 Bus Lines with Highest Rank of Bus Frequency



## (2) Inter-municipal Bus Lines

Inter-municipal bus lines connecting the central urban areas of Bogota with the surrounding sub-urban areas such as Chia, Cota, Tenjo, Funza, Mosquera, Soacha, etc. are shown in Figure 5.3-14. As can be seen, most of the lines are connected with Soacha region. Other major lines come from Facatativa, Norte. However, the information for bus operation by bus companies registered outside Bogota is limited with regard to the details of bus lines, frequency, number of companies, etc.

Figure 5.3-15 shows the trip distribution of bus passengers who pass through the border of Bogota. As can be seen, there are three large movements: one is between the central areas and the southwest regions (mainly Soacha), the second is between the central and the northwest (Cata, Tenjo, etc.) and the third is to the north of central area (north business district) across the boundary of Bogota from the north (Chia, Cajica, etc.). The inter-municipal travel demands show that the many passengers directly travel to the central areas of Bogota. This indicates that the destination of these passengers is almost in the central commercial areas.

These major movements are not across each other, i.e., the many passengers from north and northwest don't move to the deep south. On the other hand, the passenger volumes across the north business district from the southwest are low. This indicates that the passengers who travel from north to deep south or from south to north are low in volume, and those long trips are considerably low.

## (3) Tariff System

### 1) Actual Tariff

The current fare system of bus transport in Bogota is shown in Table 5.3-6. The fare rates by type of vehicles and by type of service are not adopted in proportion to travel length, i.e., a flat fare rate system by day and night. The rates are raised at the same rate as the change in price index, 15-20 % per annum. The fare rate of Bus Corriente (ordinary bus) is 350 pesos/ride for day time, in contrast to 400 pesos/ride at night time. Bus Ejectivo and Super Ejectivo change the most expensive fare at 600 pesos in day time, respectively. Super Ejectivo of Buseta is also expensive at 550 pesos.

Table 5.3-6 Tariff Table

Vehicle/Model		(pesos/ride)			
		Until 96-04-14		Since 1998	
		Day time	Night Time	Day time	Night Time
Bus	Corriente -1977	180	220	350	400
	Corriente 1978-90	200	240	350	400
	Intermedio 1991-	330	370	550	600
	Ejectivo	400	440	600	650
	Super Ejectivo	400	440	600	650
Buseta	Corriente -1974	130	170	250	300
	Ejectivo 1975 -	250	290	400	450
	Super Ejectivo	300	340	550	600
Microbus		340	380	550	600

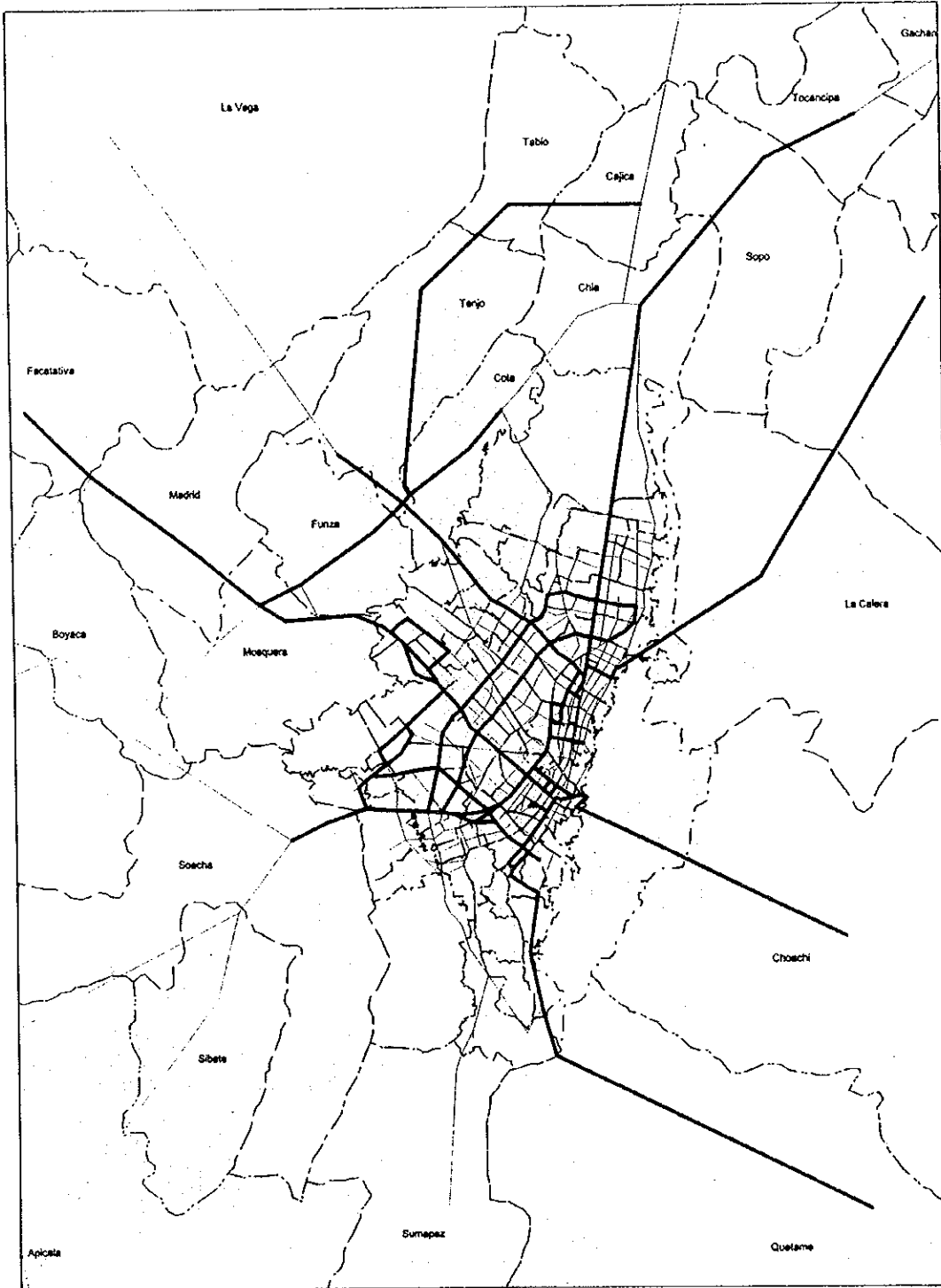


Figure 5.3-14 Existing Inter-municipal Bus Lines

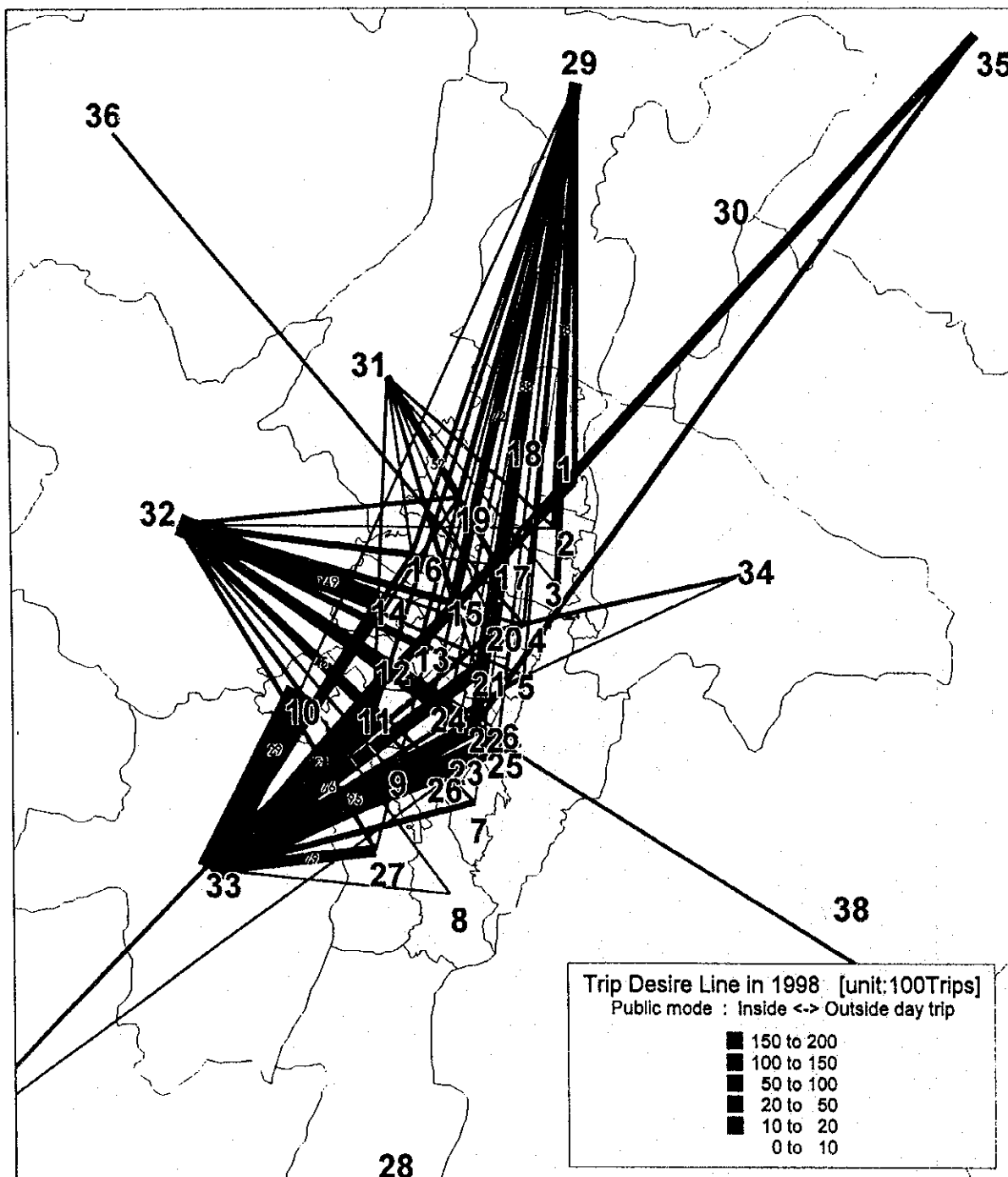


Figure 5.3-15 Trip Distribution of Bus passengers Who Dwelled outside Bogota

2) Trend of Bus Fare

Figure 5.3-16 shows the past trend of bus fare rates in Bogota. As can be seen, all bus fares are raised at the same rate as the change in price index exclusive of Bus Corriente and Bus Superejectivo. The increase rate of Bus Corriente fare rate is higher than that of the price index, while the bus rate of Bus Superejectivo is pegged in line with the price index.

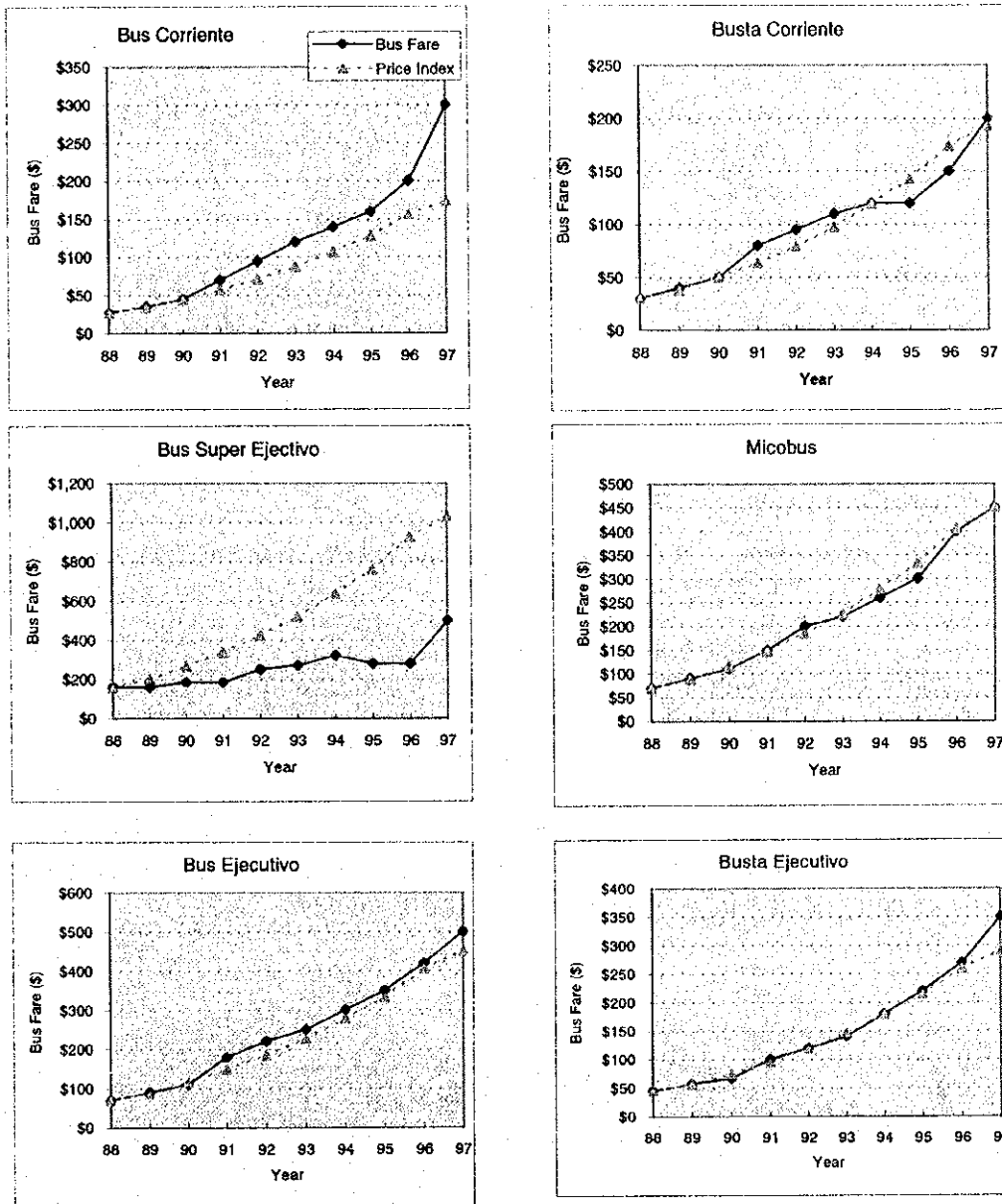


Figure 5.3-16 Past Trend of Bus Fare Rate

3) Ratio of Transportation Fare to Family Monthly Expenses

Table 5.3-7 shows the ratio of transportation fare to monthly family expenses in Bogota carried out by DANE in 1994 - 1995. The average expense of transportation fee by family is approximately 45,600 pesos/month for class 1 which is not available for commuter or

school buses(company or school), and 34,800 pesos/month for class 2 which is available from them.

The ratio of transportation fee to the monthly expenses is approximately 7% in class 1, of which about 3% are shared by only Bus, and 2% for Buseta and Colectivo, respectively.

Table 5.3-7 Ratio of Transportation Fare to Monthly Family Expenses in Bogota

	No. of Family interviewed	Total Expenses (\$1000pesos/month)	Average Expense/ Family			
			Class 1 (\$pesos/mnth) Ratio		Class 2 (\$pesos/mnth) Ratio	
Total Expensis	1,251,314	852,417,632	681,218	100.0%	681,218	100.0%
Total Transportation	955,169	43,527,936	45,571	6.7%	34,786	5.1%
Bus	682,986	13,475,738	19,731	2.9%	10,769	1.6%
Buseta	441,081	6,056,671	13,731	2.0%	4,848	0.7%
Colectivo	213,610	2,764,638	12,942	1.9%	2,209	0.3%
Intermunicipal Bus	120,800	4,387,385	36,319	5.3%	3,506	0.5%

Source: DANE

Class 1: Commuter or school buses unavailable provided by company

Class 2: Commuter or school buses available provided by company

### 5.3.5. BUS FACILITIES

#### (1) Bus Exclusive Lane

At the present, bus exclusive lane has been introduced on Av. Caracas, where busway track is located along the existing right-of-way in the center of the road (median) without any special operating measures. Figure 5.3-17 shows the typical cross section of Av. Caracas bus exclusive lane. The road is improved to a 4-lane road in each direction, divided into two: 2 lane for busway with a width of 6.60 meters and 2 lane for other vehicles, with a width of 6.00 meters. The island bus stops have an average 2.5 m. Each bus stop is on-line bays with no special overtaking facility for a total length of 24 m. Distance between bus stops is maximum 600 m.

As for the relative locations of traffic signals and bus stops, the traffic signals are located immediately both downstream and upstream from a bus stop. Passengers cross the busway on at-grade pedestrian crossings, using controlled traffic signals.

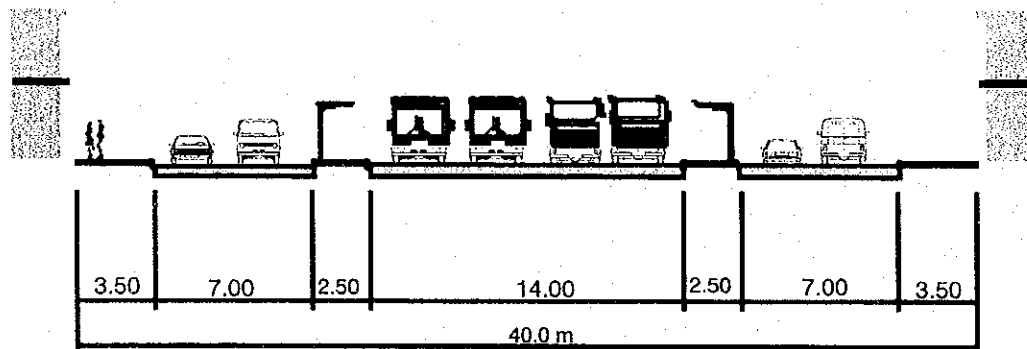


Figure 5.3-17 Cross Section of Av. Caracas Bus Exclusive lane

## (2) Bus Terminal

### 1) Urban Bus Terminal

There is no special urban bus terminal facility exclusive of the terminal for inter-regional bus. Usually bus companies illegally use the streets in the urban area or the public spaces for parking or as a terminal. However, the bus companies have 615 so called neighborhood terminals, usually in the suburbs of the city. Three neighborhood terminals were constructed in Aurora II, Molinos and Diana Turbay, all of them are located in the south of the city. Every bus terminal has a service module (toilets, cafeteria, dispatch office and control office), platforms, parking space and shield bus stops. Roads connecting each terminal are paved. Nowadays they are not operating properly because of the lack of control.

### 2) Inter-regional Bus Terminal

Bogota Bus Terminal company established in 1980 developed the Central Bus Terminal at Salitre opened in 1984. This terminal services the inter-regional buses with route distances over 50 km from Bogota. Dispatch buses in the terminal are nationwide. The terminal facility has a boarding platform, toilets, storage, taxi stand and public transport area. There are 61 companies for inter-city passengers transport, operating, buses, busetas, minibuses and taxis. Fare system depends on travel distance, level of service and terminal used.

## (3) Bus Stop

Bus stop type is mainly on-line bays with no special overtaking facility. STT approves the settlement of bus stop. Many bus stops were constructed through financing by private companies which obtain advertising revenue by putting advertisements on bus stop facility, exclusive of construction by IDU. A design of bus stop is not controlled by STT. The existing bus stops are not located uniformly. Since bus stops on Av. Caracas were constructed by IDU designed by DAPD, there are no advertisements at bus stop facility.

Since bus bays are not necessary used for boarding or alighting, buses are not designated to particular bays. Therefore, interaction between passengers loading and unloading at bus stops and passengers waiting for different bus line services occurs at major bus stops. This creates conditions which can reduce the capacity of a bus lane or busway.

### 5.3.6. EXISTING PROBLEMS AND ISSUES

As mentioned in this Section and also already disclosed in the Master Plan study, several problems and issues are pointed out in the current public transport system in Bogota from the view points of administration, user and operator. A summary of the current problems and issues is shown in Figure 5.3-18 which illustrates the relationships with cause and effect.

#### 1) Major Problems of Phenomena

Following four (4) main problems for the bus service under the traditional bus system which can no longer function in a large city like Bogota are identified:

- Too long routes
- Too many routes
- Too many fleet
- Too low fare

Every bus route concentrates into the central area in Bogota from the residential areas near fringe of Bogota. The average route distance is too long, comparing to the average travel distance. Its figure is approximately 25 km, in contrast to 9 km for the average travel distance. The bus operations are carried out on approximately 860 bus routes with 22,000 buses and its routes concentrate on some major roads. Bus fare in Bogota was kept at a constant level for a decade in line with price index. Bus fares have been controlled by political decisions. However, it is apparent that daily sales cannot cover the capital cost.

## **2) Causes of the Problems**

The backgrounds of the four major problems are:

- Uncontrollable operations
- Route cut
- Difficulty in catching a bus
- Excessive competition and low sales

Illegal operations and old and dirty fleet cause the excessive competition and low sales. Difficulty in catching a bus also causes too many bus routes. This is because bus passengers must catch a bus to be selected from among many bus route services.

Those problems involve the administration of STT that must control the prevailing illegal operation such as route change and short cut. Loading and unloading at non bus stop is daily cause for speed slow down at some points, especially at intersections, near shopping centers of great traffic demand, etc.

Rough driving and frequent overtaking create bad driver's behavior. Bus facilities without bus bays for buses to overtake one another (and thus to avoid blockages) are additional causes for poor services.

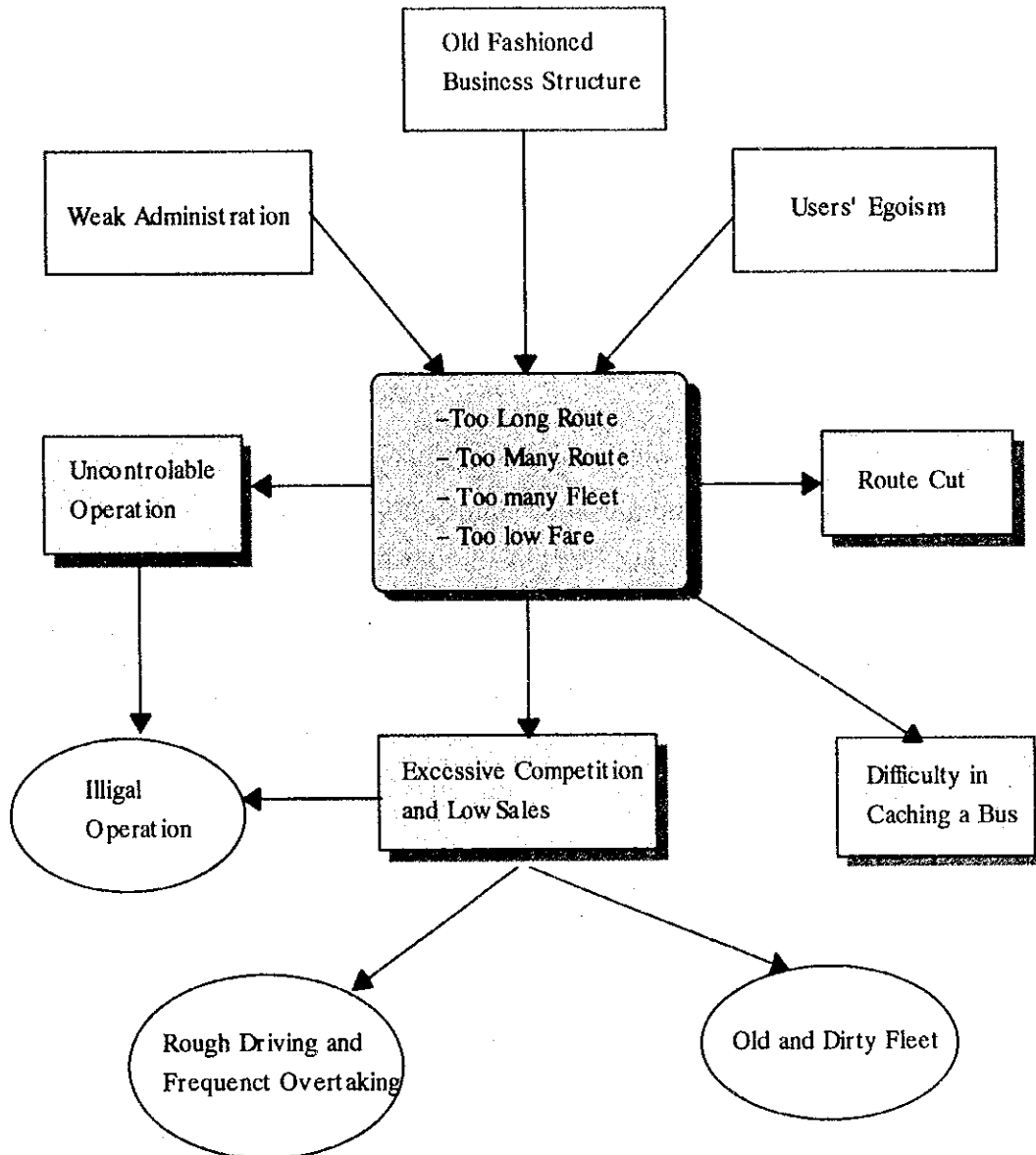


Figure 5.3-18 Main Issues of Current Bus System



## 5.4. BASIC PLANNING POLICY AND STRATEGY

### 5.4.1. BASIC PLANNING POLICY

#### (1) Objectives

Buses are one of the most space-efficient and cost-efficient means of transporting large numbers of people. Where traffic flows are well below the capacity of the road network, buses can share road space with other traffic and, in general, there is little need for special priorities for buses. However, in Bogota where road traffic volume is high in relation to road capacity, buses suffer from the congestion and delay caused by other road users, and priority measures are needed to release buses from congestion of traffic and bus transport itself.

In the Study, taking into account the existing problems and issues of current bus system, the planning objectives pursue the following fundamental policy:

- **To provide a rapid, economic and reliable public transport system**

The passenger demand exceeds the bus supply in the current system, especially in the peak hours. The current buses are not comfortable for travel. In order to shift the car owners to public transport, it is necessary to improve the level of the service through concrete measures. Therefore, it is necessary to improve the bus commercial speed and service frequency by introducing rapid system links to decrease the waiting time at bus stop. It is possible to reduce the number of buses operated under the new system and to improve the bus company expenditures and operations from the economic point of view. And also it is indispensable to maintain bus punctuality by on-schedule operation from the reliability point of view.

#### (2) Planning Approach

The planning approach will consider the following matters.

- 1) To give priority to public transport for public space usage
- 2) To maintain present level of fare system
- 3) To minimize negative impact on existing public transport business
- 4) To minimize project cost for public transport planning

The public transport needs a space for many types of facilities such as many bus terminals, bus stops, bus operation lanes, bus parking, etc. The high priority of public space usage for bus facilities must be given for new bus system.

Many bus passengers are sensitive for the level of bus fare. The passengers select bus routes in consideration of travel time and bus fare. Therefore, the level of bus fare must be maintained at the present level when new bus system will be introduced.

There are 66 companies operating bus transport with approximately 850 bus routes. Approximately 20,000 buses are operated by many employers. Therefore, the negative impacts must be minimized in the new bus system. Restructuring of existing bus system will face difficult problems and opposition. Therefore, generally accepted development scenario should be proposed for discussion with related authorities.

The projects with low investment cost should be proposed by the Study due to the limited budget of Bogota City for development of infrastructure.

### 5.4.2. TRUNK BUS SYSTEM

In the Master Plan Study, trunk bus and bus express system development were recommended as high priority projects taking into consideration the importance of strengthening the public transport system in Bogota.

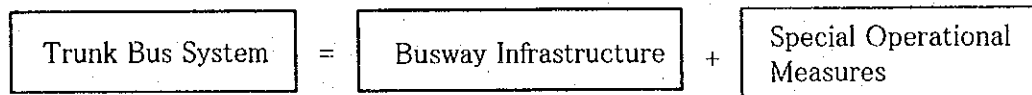
In general, bus priority measures are mainly two: bus lanes and busway. Bus lanes are road lanes reserved for the use of buses only. There are two main types of bus lanes: with-flow and contraflow.

A busway involves construction where schemes may be partially segregated from other traffic or fully segregated from other traffic by curbs or fences. A basic busway is essentially a traffic engineering measure. However, performance of this basic busway can be enhanced substantially by adopting various "special operational measures" in order to form a "busway transit system".

Trunk-and-feeder operation also offer good performance as one of a busway transit system. In this system, feeder buses collect passengers and bring them to a transfer terminal, where they transfer to trunk buses. In Bogota, busways have been implemented as traffic management measures without any substantial modifications to bus operations. Busways must be introduced in conjunction with special operation measures to form a mass transit system.

#### (1) Trunk Bus System

Trunk bus system is composed of busway infrastructure and special operational measures as follows:



#### 1) Busway Infrastructure

- Partial or full segregation from other traffic by " paint and sign ", fences or curbs.
- Island Bus stops / off-road bus stops.
- Terminals

#### 2) Special Operational Measures

- Bus overtaking facilities at stops
- Trunk and feeder operations
- High capacity buses
- Off-board ticketing
- Bus dwell time management
- Bus-priority signal at intersections.

Line-haul capacity on the trunk busway can be enhanced by the use of high-capacity buses, including articulated, double-deck or with the use of bus+trailer. However, passenger transfer capacity at bus stops is often the constraint on system performance, and door configuration and ticketing arrangements are often more important than bus capacity alone.

The main advantages of busway system are

(Cornwell and Cracknell, 1990):

- Flexibility
- Affordability
- Self-enforcement
- Scope for incremental development
- Existing experience

One of the main disadvantages of busway transit, however, is that their implementation requires the active cooperation of road authority. Because busway can be introduced along existing roads, a busway can run along the middle of the carriageway (median busway) or next to the curb (lateral busway).

More than forty busways exist worldwide, though only a few cities have developed them in a systematic and comprehensive manner as the framework of the city's mass transit network. The best example of the widescale use is in Curitiba in Brasil.

## **(2) Trunk Bus Network for Study**

Eleven (11) trunk bus network are studied as shown in Figure 5.4-1. Six (6) busways are based on JICA Scope of Work, and the remaining are for on going projects of the Bogota City. Those roads have high passenger demands and also heavy vehicle demands according to the survey data and assignment analysis. The number of passengers transported by buses on those roads is substantially more than that by private cars. If roadspace is allocated to buses, the roadspace must be used effectively.

When a busway is to be inserted into an existing right-of-way, difficult issues arise over the allocation of roadspace between the buses and private car users. Those road capacities are reduced by construction of busway and traffic congestion will be more severe after the construction, while travel conditions of bus passengers are improved.

Figure 5.4-2 illustrates the trade-off between traffic flow and bus flow: the chart indicates that this trade-off can be classified into four basic categories. The central area in Bogota is Case 4: this is where bus priority is most needed, but other road users must accept the severe traffic conditions caused by allocation of roadspace to buses.

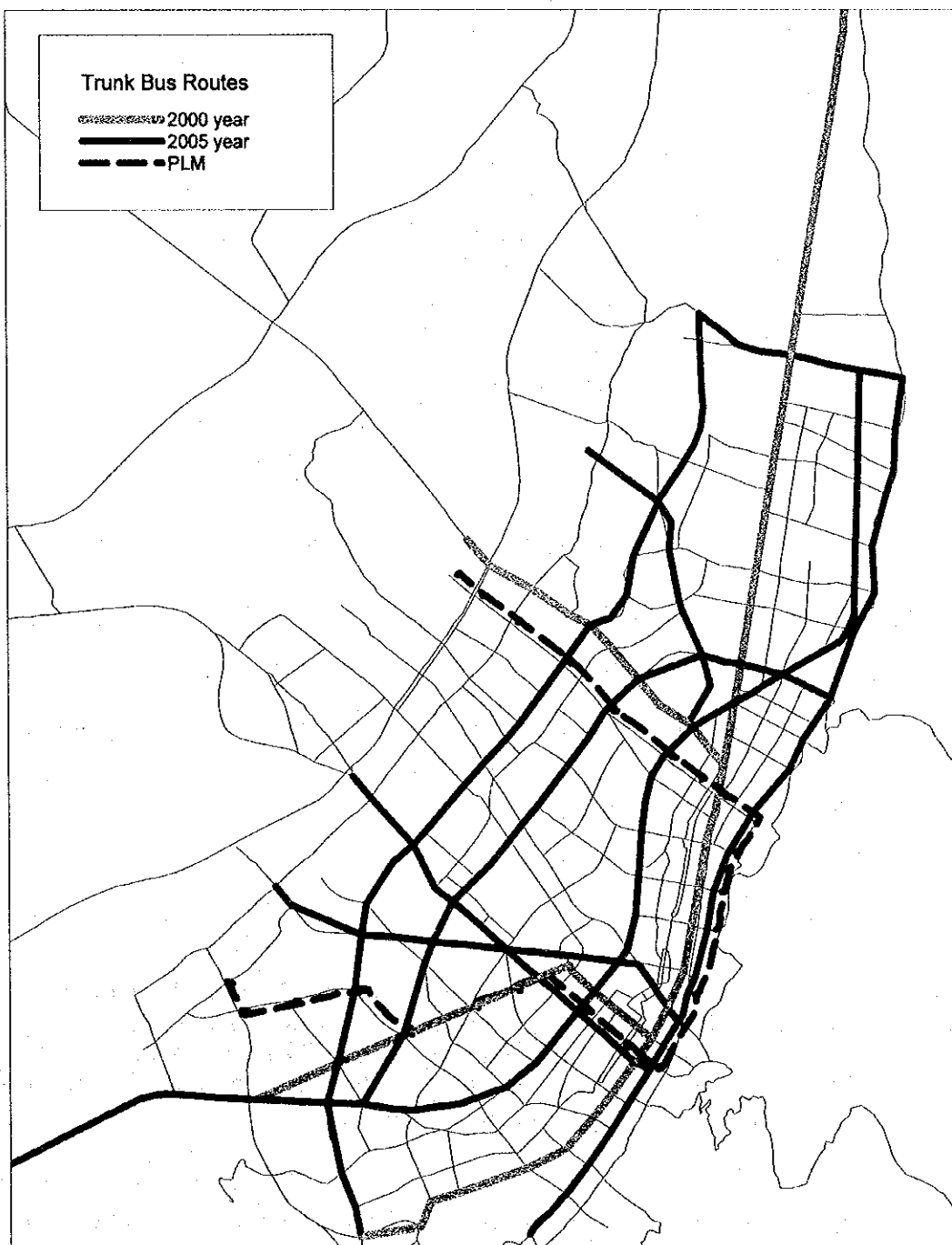


Figure 5.4-1 Trunk Bus Network for Study

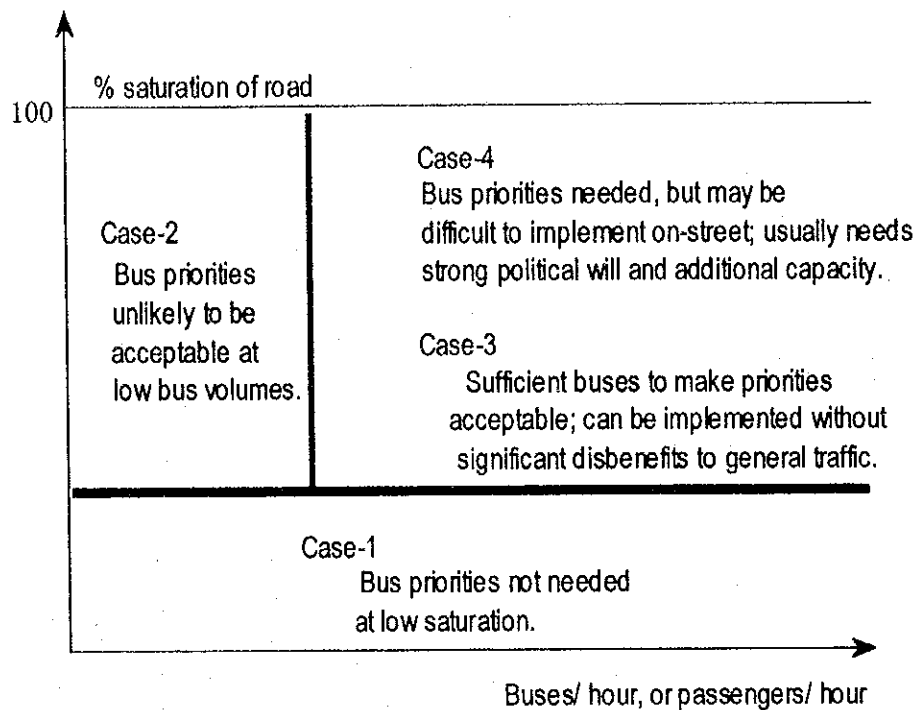


Figure 5.4-2 Feasibility and Warrants of Busway

### 5.4.3. PRECONDITION FOR PLANNING

#### (1) Target Year or Bench Mark Year

The target years of trunk bus system in consideration of a project life of 10 years are as follows:

- In the year 2000: stage 1 completed
- 2005: stage 2 completed
- 2010: intermediate forecast years
- 2015: final forecast year

The development plan of trunk busway is shown in Figure 5.4-3 which illustrates the stage planning in 2000 and 2005, respectively. In 2000, three (3) network are developed: Av. Caracas - Autopisata Norte, Av. 80 and Corredor Ferreo, which are planned by IDU. In stage 2 in 2005, eleven (11) busway network will be completed and trunk-and-feeder bus operation will be commenced in the year of 2005.

#### (2) Other Infrastructure

There are many existing urban transport projects in Bogota such as the mass transit railway project, trunk busway projects, and the road construction and improvement projects. This Study will be conducted while being mindful of the other projects. The major transport and road projects are as follows:

- Railway: in the year 2005: stage 1 completed  
2010: stage 2 completed

- Urban expressway: in the year 2005: stage 1 (inner ring) completed
- Cundinamarca toll road: in the year 2000: temporarily completed with 4 lanes
- Extension of Av. Boyaca: in the year 2000: completed

**(3) Capacity of Bus Fleet Operated on Trunk Busway**

As mentioned before, it is indispensable to operate high capacity buses as special operation measures in the trunk bus system. Bus capacity used for trunk and feeder operations will be employed as shown below:

- Trunk bus: 80 - 100 passenger / unit
- Express bus: 150 – 200 passenger / unit
- Feeder bus: 15 –20 passenger / unit

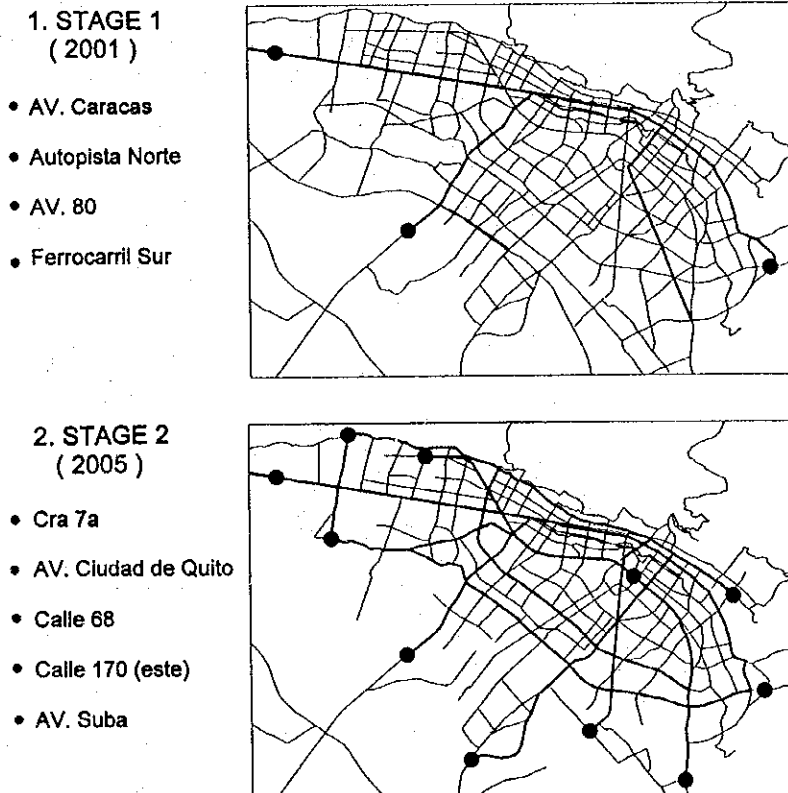


Figure 5.4-3 Development Plan of Trunk Bus System

**5.4.4. ALTERNATIVE BUS ROUTE NETWORK**

As mentioned before, the eleven (11) busway system which is composed of busway infrastructure and special operational measures will be completed by the year 2005. The basic alternatives of trunk bus route configuration as special operational measures are shown in Figure 5.4-6. Alternative-1 shows a case without any special operation, i.e., the same system as that on Caracas. Alternative-2 is trunk and feeder operation system in which trunk bus is operated on some bus route network in the fully segregated busway, and feeder bus has function as collector of passengers by operating within residential areas.

Alternative-3 is almost the same, but operation system is different in which trunk bus only serves as a shuttle bus.

In the alternative-2, bus passengers will only board buses serving selected routes. In some cases, a bus leaving a bus stop will have no passengers on board, while in other, the bus may be full and leave some passengers waiting at the bus stop. On the other hand, the shuttle operation system in the alternative-3 can avoid those situations because the passengers will board every bus coming to bus stop, while the number of transfer rises.

### (1) Alternative Trunk Bus Line Configuration

Two alternative trunk bus line configurations are proposed as follows: alternative-A forms a bus line network connecting only adjacent terminals with each other (see Figure 5.4-4), while for Alternative-B, bus line connects every bus terminal with each other as shown in Figure 5.4-5.

Those alternatives have the advantage and disadvantage for the balance between demand and supply, number of transfer times, line length, etc. Table 5.4-1 summarizes the characteristics of two alternatives.

Actual bus lines will incorporate Alternative-A with Alternative-B in consideration of locations of bus terminals, passenger volumes for boarding, alighting and transfers at bus stops, and the passenger OD pair characteristics.

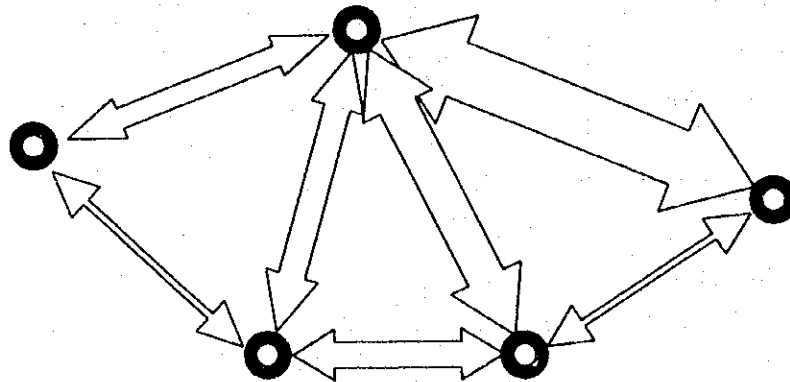


Figure 5.4-4 Alternative-A (Connecting Only Adjacent Terminals)

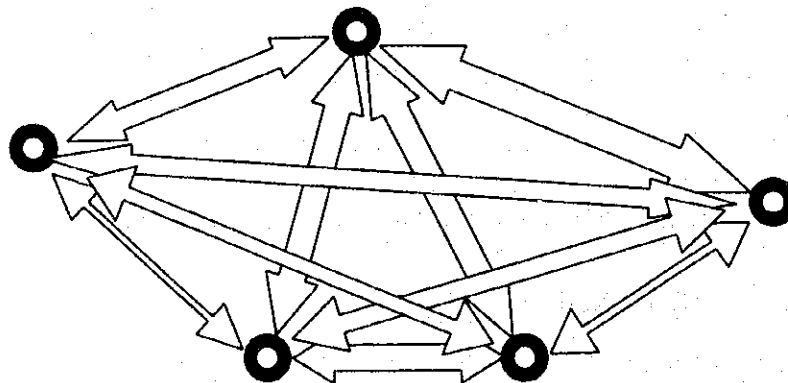


Figure 5.4-5 Alternative-B (Connecting Every Bus Terminal with each other)

Table 5.4-1 Comparison to Two Alternatives

Alternative	Advantage	Disadvantage
A	<ul style="list-style-type: none"> <li>● Short lines → easy to balance demand and supply</li> <li>● Simple and clear network</li> </ul>	<ul style="list-style-type: none"> <li>● Increase transfer</li> <li>● Limited passengers route choice</li> </ul>
B	<ul style="list-style-type: none"> <li>● Minimize transfer</li> <li>● Flexible passengers route choice</li> </ul>	<ul style="list-style-type: none"> <li>● Long lines → lower occupancy rate</li> <li>● Complex bus line network</li> </ul>

## (2) Feeder Bus Line Configuration

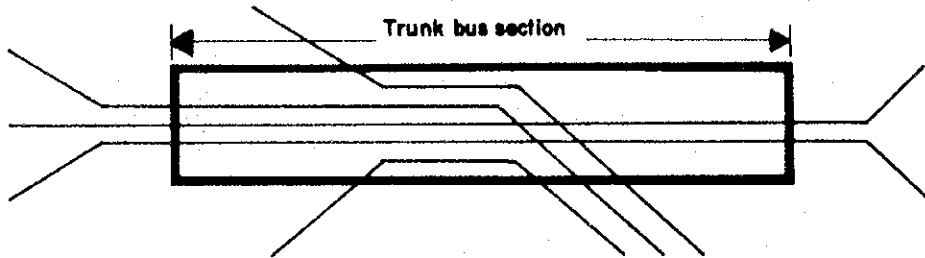
In the trunk and feeder bus system, the function of feeder buses is to supplement a service of trunk bus. The feeder buses serve within some areas where no trunk buses operate. Figure 5.4-7 shows samples of feeder bus line configurations which connect from/ to trunk bus lines with circulative line services.

The service area of feeder bus depends on an average walking distance of bus passengers. According to the survey data, the average walking distance from /to bus stop is approximately 800 m – 1 km. Therefore, the covering areas of bus service are within a width of 0.8 – 1.0 km on either side of a trunk bus line. The feeder bus is to operate the outside areas where the trunk bus service is not effective.

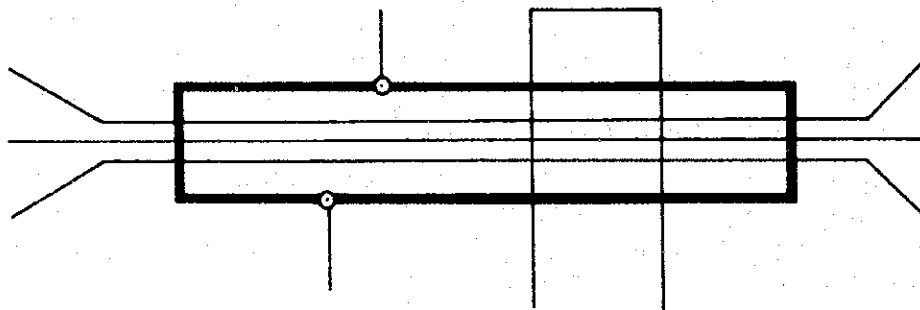
Figure 5.4-8 and Figure 5.4-9 show the influence areas of trunk bus service within 500 m and 1km, respectively, which areas represent the estimated walking distance. If the walking distance is on an assumption of 1 km, the areas between Cra. 7a and Av. Quito are covered with trunk bus service lines and the feeder bus will be mainly operated on the fringe areas in the outside of Av. Boyaca.



**Alternative 1: Exclusive Bus Lanes**



**Alternative 2: Trunk and Feeder Operation**



**Alternative 3: Shuttle Service and Feeder**

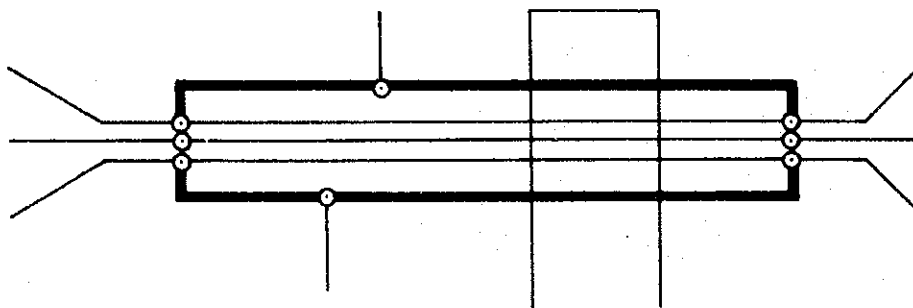
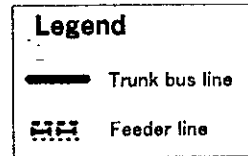
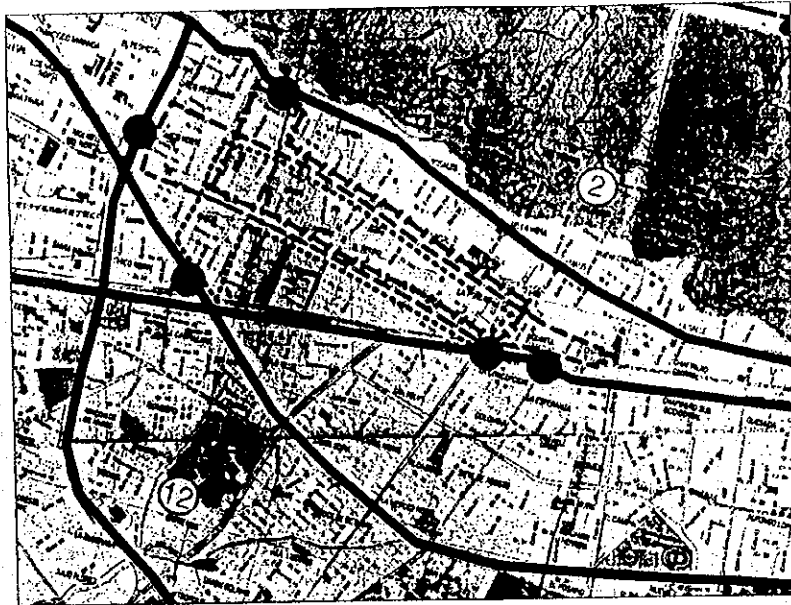
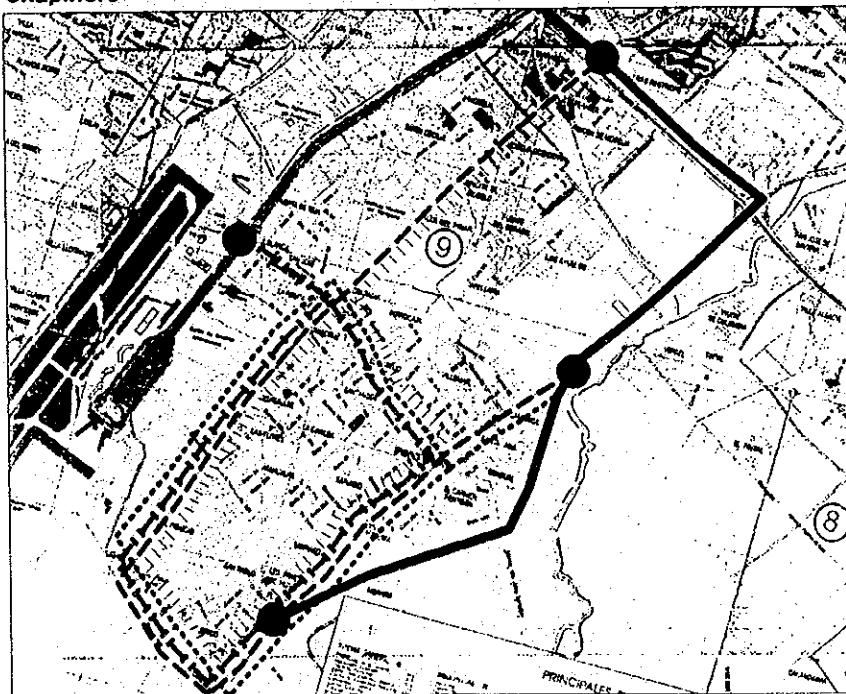


Figure 5.4-6 Trunk Bus Route Configurations



Chapinero



Fontibon

Figure 5.4-7 Samples of Feeder Line Configuration

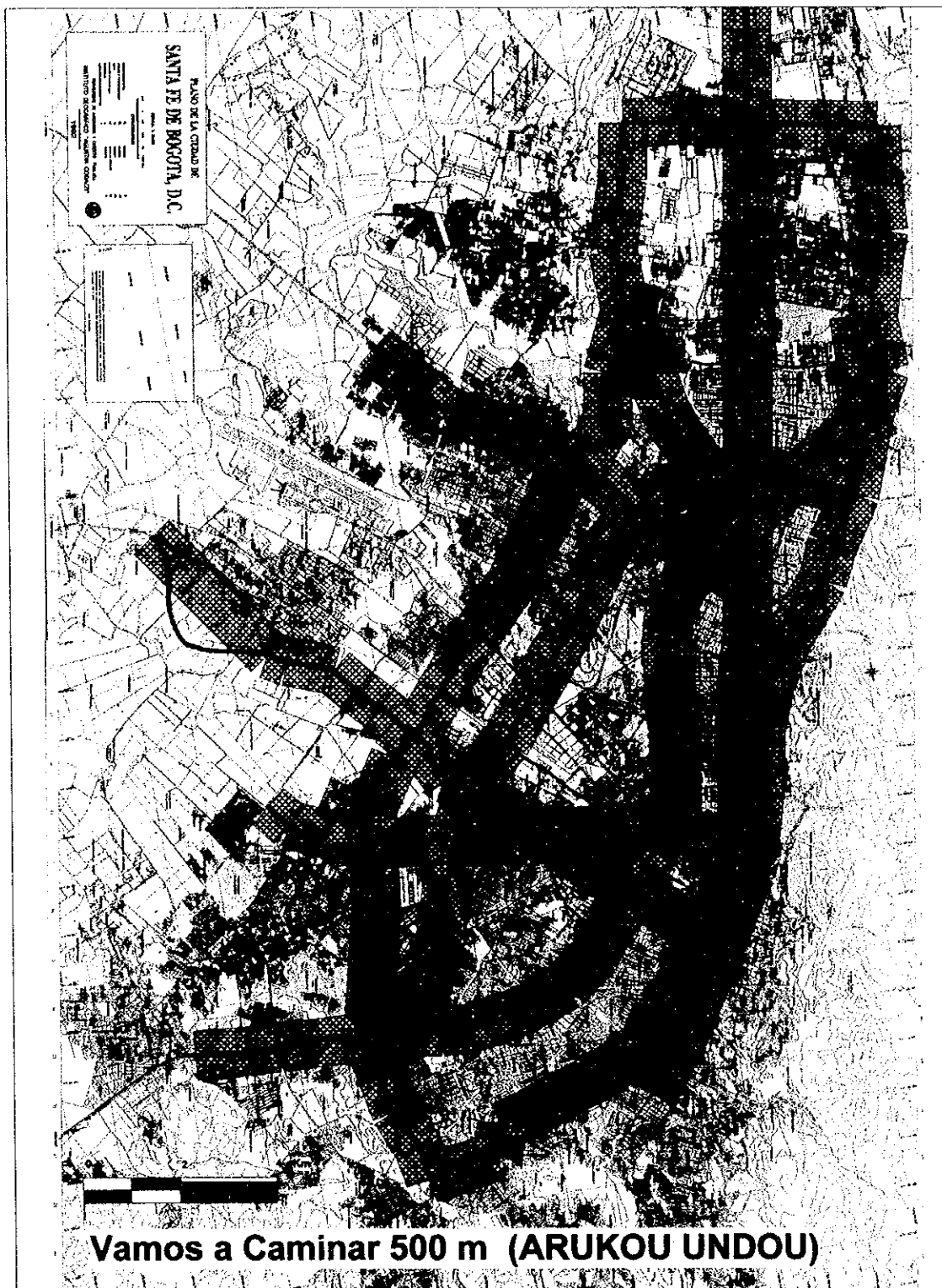


Figure 5.4-8 Trunk Bus Line Service Influence Areas (within 500 m)



Figure 5.4-9 Trunk Bus Line Service Influence Areas (within 1 km)

### (3) Inter-municipal Bus Lines

Two typical alternatives of inter-municipal bus lines connecting the central urban areas of Bogota with the surrounding sub-urban areas such as Chia, Cota, Tenjo, Funza, Mosquera, Soacha, etc. are also proposed: Alternative-A forms a bus network to terminate at suburban terminals (see Figure 5.4-10), while bus lines for Alternative-B are extended to central terminals within the urban areas as shown in Figure 5.4-11.

Alternative-B is recommendable for the passengers convenience on the assumption that reciprocal bus operation system is taken, e.g., buses which belong to Soacha come into Bogota and Bogota's buses operate into Soacha, as long as central terminals have enough capacity. Since bus line of Alternative-A is cut at suburban terminals, bus passengers are forced to transfer to other bus lines.

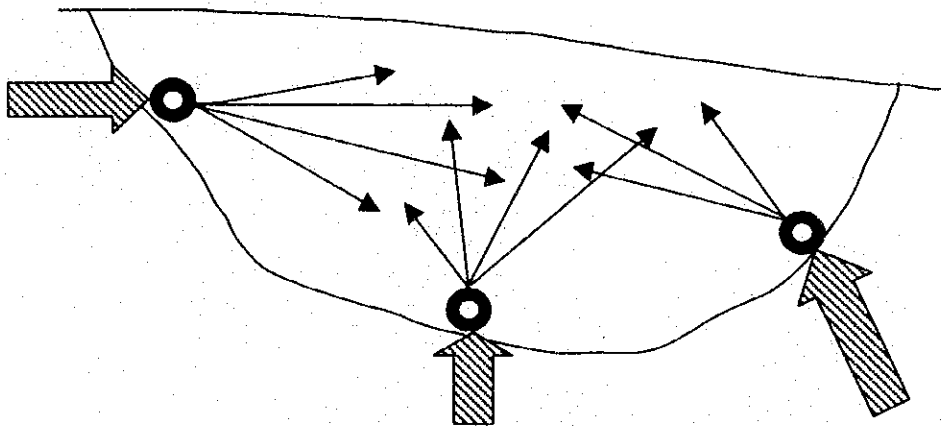


Figure 5.4-10 Inter-municipal Bus Lines (Alternative-A)

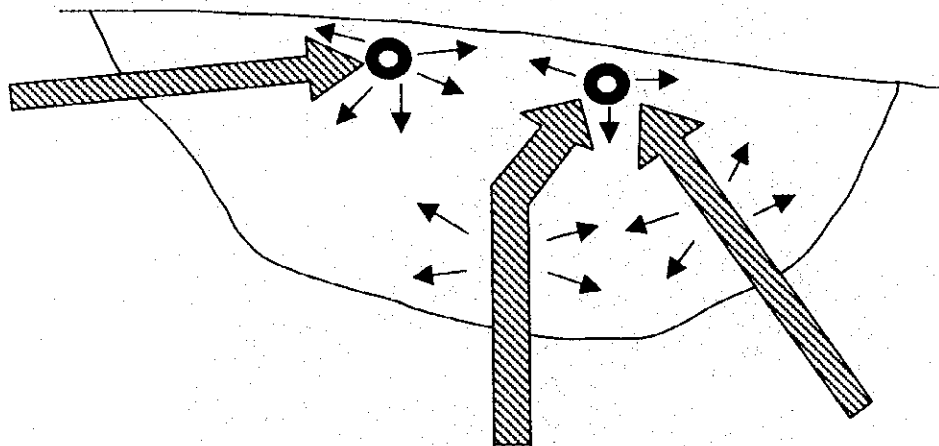


Figure 5.4-11 Inter-municipal Bus Lines (Alternative-B)

### 5.4.5. TARIFF SYSTEM

#### (1) Actual Tariff

The current fare system of bus transport in Bogota is shown in Table 5.4-2. The fare rates by type of vehicles and by type of service are adopted in no proportion to travel length, i.e., a flat fare rate system by day and night. The rates are raised at the same rate as the change in price index, 15-20 % per annum. The fare rate of Bus Corriente (ordinary bus) is 350 pesos/ride for day time, in contrast to 400 pesos/ride at night time. Bus Ejectivo and Super Ejectivo charge the most expensive rate at 600 pesos in day time and 650 at night. Super Ejectivo of Buseta is also expensive at 550 pesos.

Table 5.4-2 Tariff Table

Vehicle/Model		Until 96-04-14		Since 1998	
		Day time	Night Time	Day time	Night Time
Bus	Corriente -1977	180	220	350	400
	Corriente 1978-90	200	240	350	400
	Intermedio 1991-	330	370	550	600
	Ejectivo	400	440	600	650
	Super Ejectivo	400	440	600	650
Buseta	Corriente -1974	130	170	250	300
	Ejectivo 1975 -	250	290	400	450
	Super Ejectivo	300	340	550	600
Microbus		340	380	550	600

#### (2) Tariff of Express/ Trunk Buses (at June, 1998 constant price)

##### 1) Tariff System

Two types of tariff system are considered as follows:

- A flat rate system which is the same system as that of the current flat rate.
- A zone fare system in which the fare rises according to trip length

In the Study, alternative cases will be set on the flat rate system because the zone fare system is difficult in the actual application, especially ticket sale, fare collection and ticket validation. It is difficult to verify the ticket under the zone fare system without any fare collecting equipment.

##### 2) Alternative Cases

Two alternative cases are considered as follows:

- 1) Alternative-A: a flat rate system with an additional fare at every transfer point
- 2) Alternative-B: a flat rate system without payment of an additional fare when transferring

Alternative-B allows transfer without payment of an additional fare when passengers transfer from/ to feeder bus or trunk bus at terminal or bus stop. However, it is also difficult to verify the passengers who transfer or not by the validation of tickets only. If such system is actually introduced, some segregated structures like railway station need to validate the passengers.

### 3) Study Conditions

On the following initial conditions, tariff system in the trunk busway system is analyzed on the assumption that total sales under current system balance those under new system.

- Base case
  - Express / Trunk Bus: 400 pesos
  - Feeder Bus: 150 pesos
- Adjustment

$$\boxed{\begin{array}{l} \text{Total Sales under Current} \\ \text{System} \end{array}} = \boxed{\text{Total Sales under New System}}$$

### (3) Integrated System for Intelligent Ticket

In order to accomplish high performance in the trunk and feeder bus system, an efficient ticketing system is needed. Boarding times per passenger in a fare collection system in which entry to a bus is unobstructed by fare collection or ticket validation, are lower than that of the current system in which entry is restricted.

There is off-board ticketing system as an intelligent ticketing system. It offers the possibility to reduce passenger service time and thereby to reduce bus dwelling time and increase commercial speed.

Figure 5.4-12 shows typical integrated systems for intelligent ticket used in Japan. Figure 5.4-13 to Figure 5.4-15 show the fare collectors, magnetic cards and tickets and display equipment of next bus stop and zone fare which are components in the integrated system.

Such system introduced on only several busways will not be effective. The integrated system to be applied in the whole city would enhance the performance of the trunk and feeder bus system, if no notice is taken of the cost.

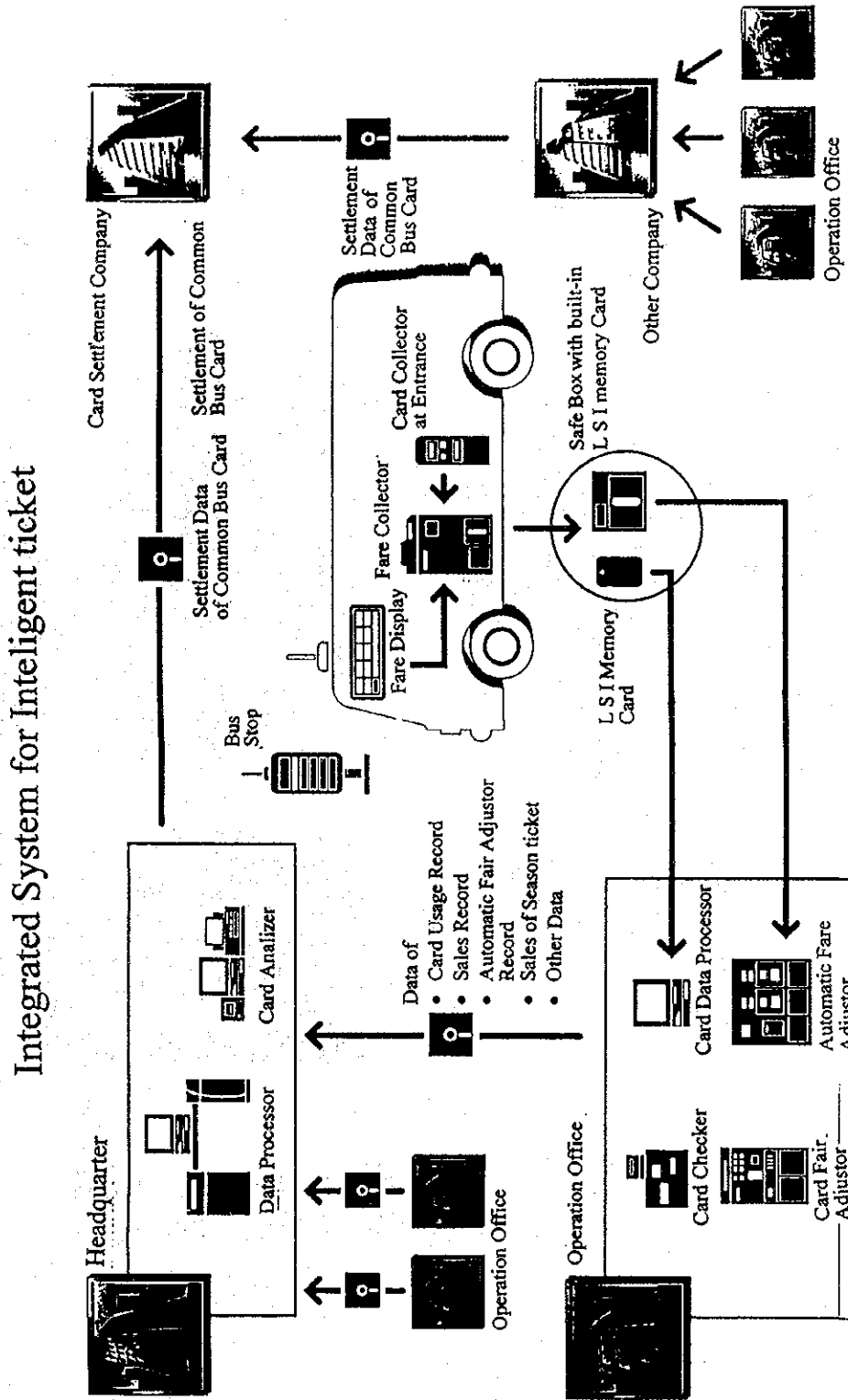
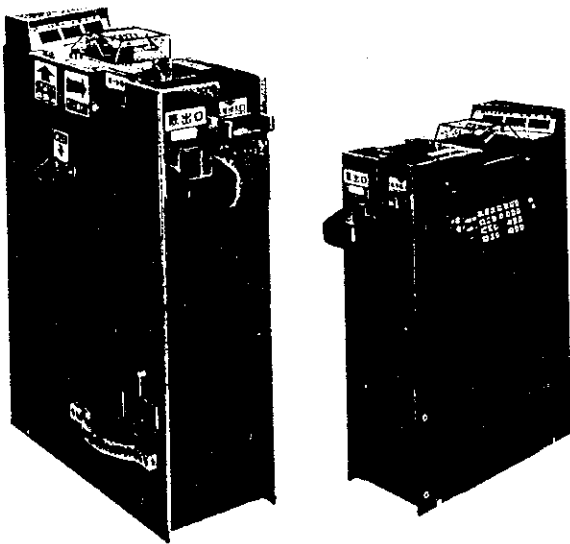


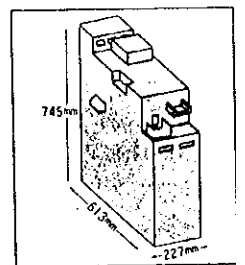
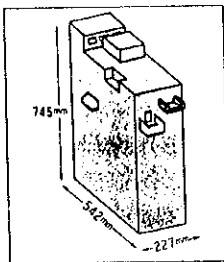
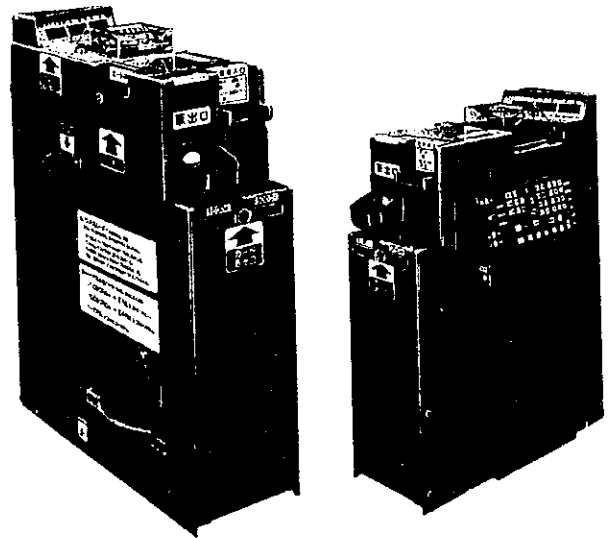
Figure 5.4-12 Integrated Systems for Intelligent Ticket



(1) Card Reader Built – in  
Fair Collector



(2) Fair Collector with  
Card Vendor

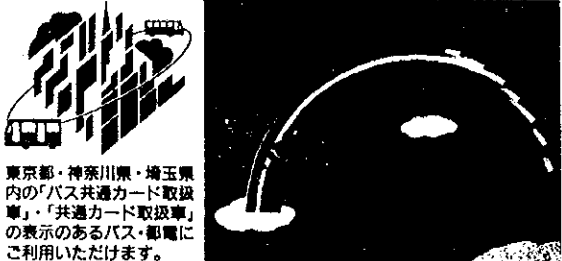


Cost: 1.3 – 1.4 million pesos / unit  
(Approx. 10 % of fleet cost)

Figure 5.4-13 Fare Collectors

● Common Bus Card

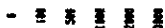
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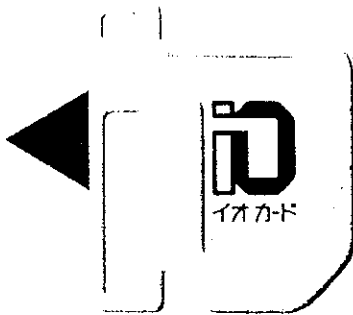
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Front

Back

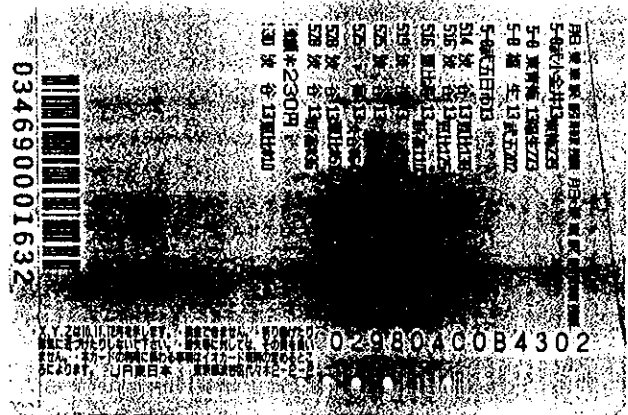
iO-CARD 3000



JR東日本専用

・イオカードのロゴマーク表示(①)のあるJR東日本の自動改札に専用設置してご利用いただけます。ただし、乗券記録装置を添えてご利用はできません。  
・入券時に本人の指紋の登録を必ず行います。  
・イオカードで入券の場合、他の改札での乗降はできません。  
・新幹線、特急・急行列車にはご利用できません。  
・入券券としてはご利用になりません。  
・自動改札で乗降された場合は、カードに乗車月日・乗車駅・乗降位置(10分単位)・乗車駅・距離(10分単位)が印字され、入券当日に限り有効です。  
・自動改札で出券の際に乗降不足の場合は自動検票機で、自動改札のない改札口で乗降の場合は改札口で検票機を使用して下さい。  
・乗降券のグリーン券・スイートシートはあらかじめお申し込みください。お申し込みが完了した場合は乗降券の乗降までのお支払いとなります。  
・イオカードのロゴマーク表示のあるJR東日本の乗車券売場や自動券売機でもご利用いただけます。  
・乗降不足の場合、乗車又は降車カードをあわせてご利用下さい。  
・残額は自動改札機、自動券売機等に表示されます。

JR東日本



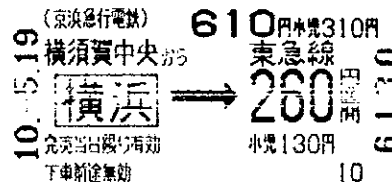
Usage records are printed  
(date, boarding, station, balance)

● JR Ticket



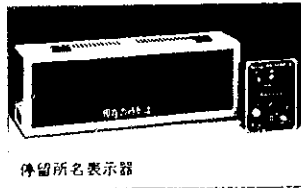
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JR - Tokyu Line Transfer Ticket

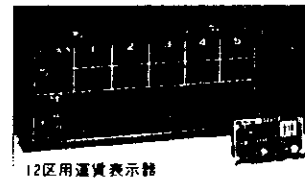


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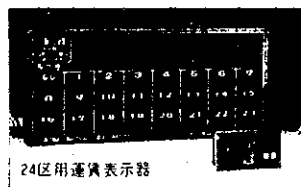
Figure 5.4-14 Magnetic Cards and Tickets



**Next Bus-Stop Display**



**Fair Display (12 Zones)**



**Fair Display (24 Zones)**



**Fair Display (32 Zones)**



**Ticket of boarding bus stop**

Figure 5.4-15 Display Equipment of Next Bus Stop and Zone Fare

**5.4.6. CO-ORDINATION WITH CURRENT SYSTEM**

The application of trunk and feeder bus system in Bogota requires the restructuring of existing bus system such as bus rerouting, replacement of bus fleet with high capacity buses, etc. This section focuses on phase out of old bus fleet by the target year.

**(1) Scheduled Phase Out of Old Fleet (Law 105, Dec. 1995)**

Table 5.4-3 shows the scheduled phase out of old fleet under law 105, Dec. 1995. According to Table, vehicles which are made in 1978 or earlier can not be used as of 2000 though the prolonged vehicle life is taken into account. On December 31, 2001, the vehicles produced by 1981 and older can not be used for operation.

Table 5.4-3 Scheduled Phase Out of Old Fleet

By the date of	No use of vehicle older than	Vehicles to be operated																	
		70			75			80			85			90			95		
1995/06/30	1970 and older	[Shaded area from 1970 to 1995]																	
1996/12/31	1974 and older	[Shaded area from 1974 to 1996]																	
1999/06/30	1978 and older	[Shaded area from 1978 to 1999]																	
2001/12/31	20 years	[Shaded area from 1981 to 2001]																	
After 2002	20 years	[Shaded area from 1982 to 2002]																	

Note: [White box] Prolonged vehicle life for model 1971-74 until 1998/12/31 by Law 336/1996.

**(2) Entry of Present Operators to New System**

Entry of present operators to new system will be accomplished in accordance with the scheduled phase out of old fleet. Figure 5.4-16 illustrates the situations of entry coinciding with phase out of old fleet.

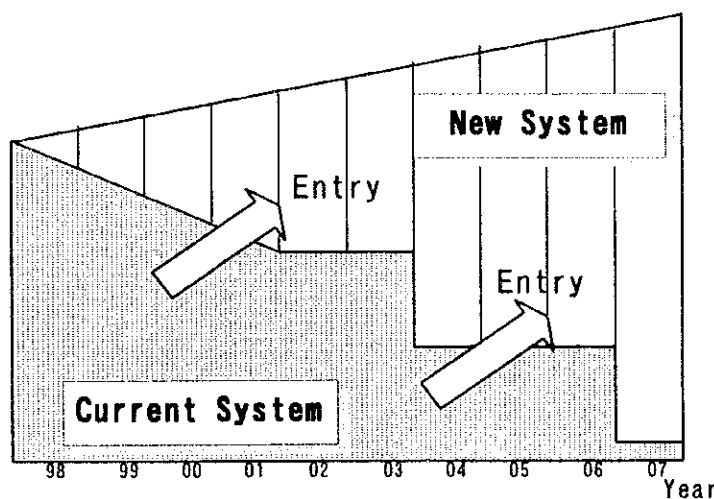


Figure 5.4-16 Illustration of Entry to New System

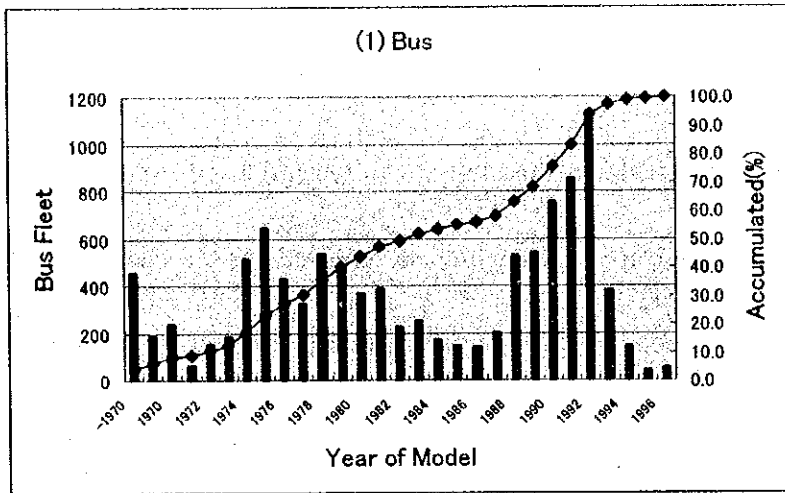
**(3) Age Distribution of Existing Bus Fleet**

Figure 5.4-17 shows the age distribution of existing bus fleet by bus, buseta and Microbus. As can be seen, bus ages of microbuses are considerably new-fashioned, while bus and

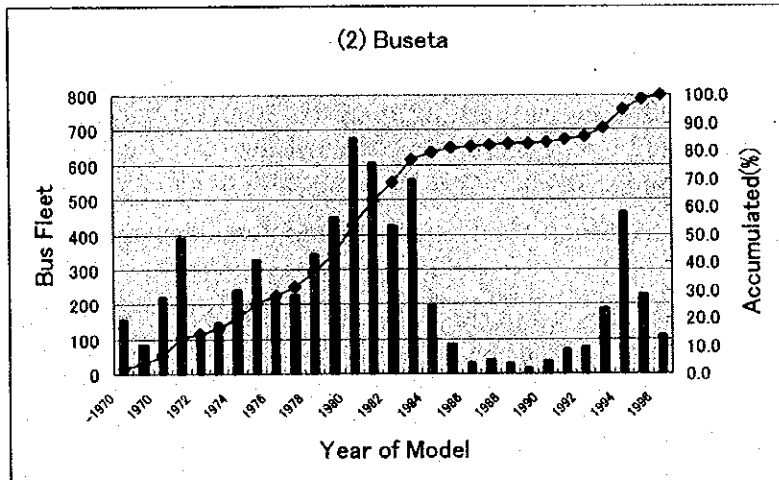
buseta are old aged. The production models of present Buses are classified into 2 groups: one is in the middle of 1970's and the other is in the beginning of 1990's. Buseta has similar situation as that of bus.

The Tables on the right side of the Figures show survival ratio of each year by type of buses. According to the figures, until 2001, the survival ratio of bus and buseta are approximately 55% of the total buses and 56%, of the total busetas, in contrast to 98% for microbus. As of 2010, the ratio of bus and buseta are as low as 32% and 17%. Microbuses remain at high ratio of 92%.

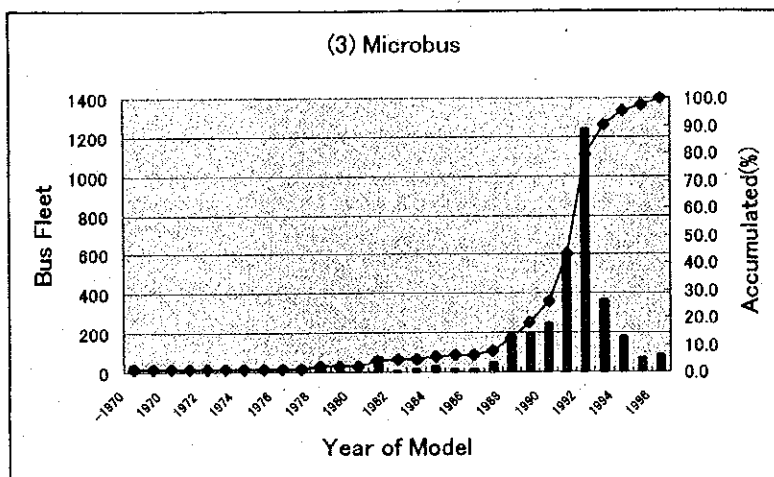
On the target year of 2005 for trunk and feeder bus system, half of the buses will be replaced by new high capacity buses.



<b>Total Fleet</b>	10,577 unit
<b>Survival Ratio</b>	
2001:	56.5%
2005:	46.8%
2010:	32.0%



<b>Total Fleet</b>	6,778 unit
<b>Survival Ratio</b>	
2001:	56.7%
2005:	20.4%
2010:	17.4%



<b>Total Fleet</b>	3,409 unit
<b>Survival Ratio</b>	
2001:	98.0%
2005:	94.3%
2010:	91.9%

Figure 5.4-17 Age Distribution of Existing Bus Fleet

### 5.4.7. FACILITY PLAN

Facility plan for the trunk bus system in the Study involves two type of facilities:

#### 1) Linear facility

- **Busway:** bus facility which is partially or fully segregated from other traffic by curbs or fences.
- **Exclusive Bus Lane:** road lane which is reserved for the use of bus only by road markings or separators.
- **Bus Priority Lane:** road lane which is essentially reserved for the use of bus by paint and sign in the morning and evening peak hours.

#### 2) Nodal facility

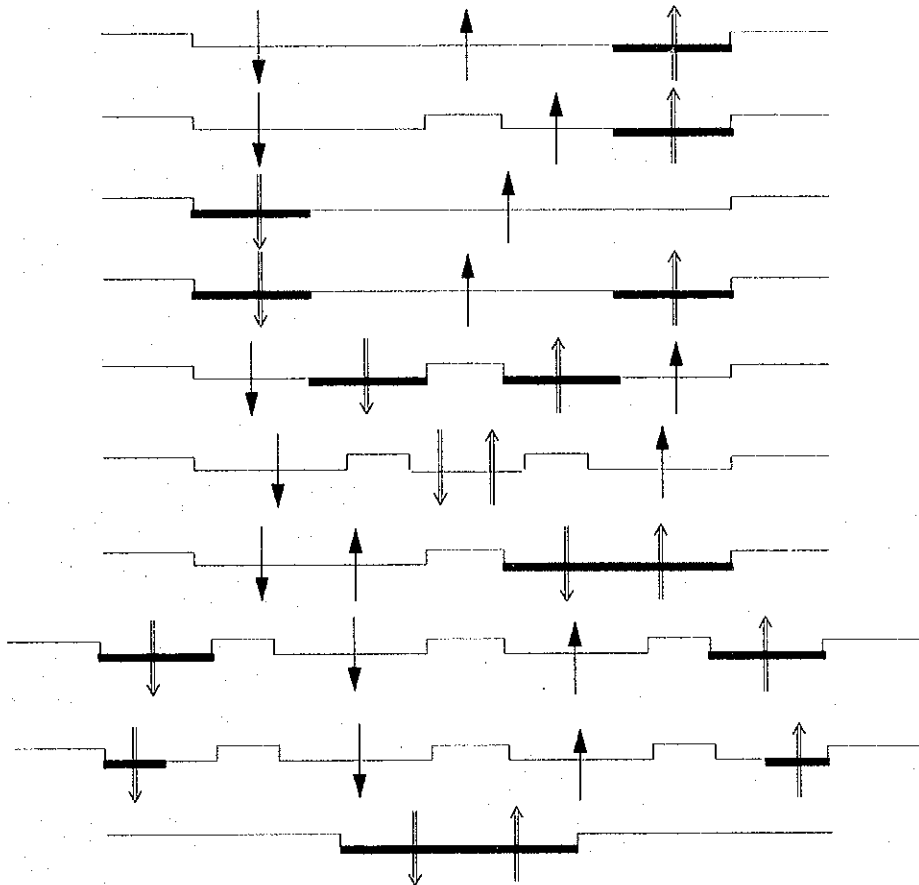
- Terminal
- Transfer Bus Stop
- Bus Stop

#### (1) Linear Facility / Track Design

Busway track may be located along an existing or a new right-of-way. For an existing right-of-way, the bus track may be located in the center of the road (median) or along the sides (lateral). Figure 5.4-18 shows the principal busway configurations.

The relative advantages and disadvantages of median and lateral busways are summarized in Table 5.4-4.

The degree of grade separation between buses and other traffic can have a major influence on performance. The general arrangement for an elevated busway is given in Figure 5.4-19. In the Study express bus system can be introduced through elevated "exclusive bus lanes" by completely segregating bus lanes from lanes in common use. It will have railway -like nature, making shuttle service from end to end of a route.



key:

Busway



Direction of travel of general traffic



Direction of travel buses

Figure 5.4-18 Principal Busway Configuration



Table 5.4-4 Advantages and Disadvantages of Busway Layouts

## ADVANTAGES

## MEDIAN BUSWAY

- Allows frontage development to be serviced from kerbside either during off-peak or by night-time unload/loading.
- Experience shows that enforcement is not a major problem ( even with separators which can be crossed by other traffic.
- If traffic volumes and network configuration permit, left-turn traffic can be accommodated by G or Q. turns to resolve intersection design problems.
- Traffic signal priority for buses facilitated as traffic turning across busway is limited.

## CONTRAFLOW, KERBSIDE BUSWAY

- Minimises bus diversions in one-way road systems.
- Fewer enforcement problems than for with-flow busway. Even with mountable separators.
- Easier to provide bus overtaking facilities at stops than in case of median busway if bays can be provided in footpath.

## WITH-FLOW, KERBSIDE BUSWAY

- Requires less space than for median busway since stops are located on existing footpath.
- Easier to provide bus overtaking facilities at stops than in case of median busway if bays can be provided in footpath.
- Although no firm data exist. Pedestrian safety is probably greater than for median busway since passenger are not isolated in the center of the road.
- Disruption to normal traffic routes is minimal.

## UNILATERAL, KERBSIDE

- Enforcement problems minimised.
- Easier to provide bus overtaking facilities at stops than in case of median busway if bays can be provided in footpath.

## DISADVANTAGES

- Requires 10.5 m minimum right-of-way for 2-lane busway, separator and island bus stop plus adequate roadspace for general traffic (usually 2 lanes in each directions)
- Traffic management measures are necessary to ensure safe operation ( eg median barriers for pedestrian control.)
- If leftturn are allowed across the busway, separate signal phases must be introduced.
- If stops are located mid-block, additional pedestrian/traffic signal will probably be required (causing extra vehicle delay)

- Problems of servicing frontage development : this must be done from side streets or across the busway (difficult with high-volume schemes)
- Initial accident problems involving pedestrians reported for several schemes.
- Introduction of contraflow busway into a one-way system may undermine the reason for the one-way system itself, since conflicts would be reintroduced at intersections.

- Problems of servicing frontage development: this must be done from side street or across the busway (difficult with high-volume schemes).
- Enforcement can be a problem unless separators cannot be crossed by general traffic (in which case problems might arise for broken-down buses).
- If the scheme extends to signal stops lines, separate signal phases must be provided (G and Q turns do not assist)

- Feasibility depends upon frontage land-use: properties fronting the busway are isolated.
- Pedestrians must cross "3-way" traffic with associated dangers.
- Special arrangements are required for bus entry and exist at intersections

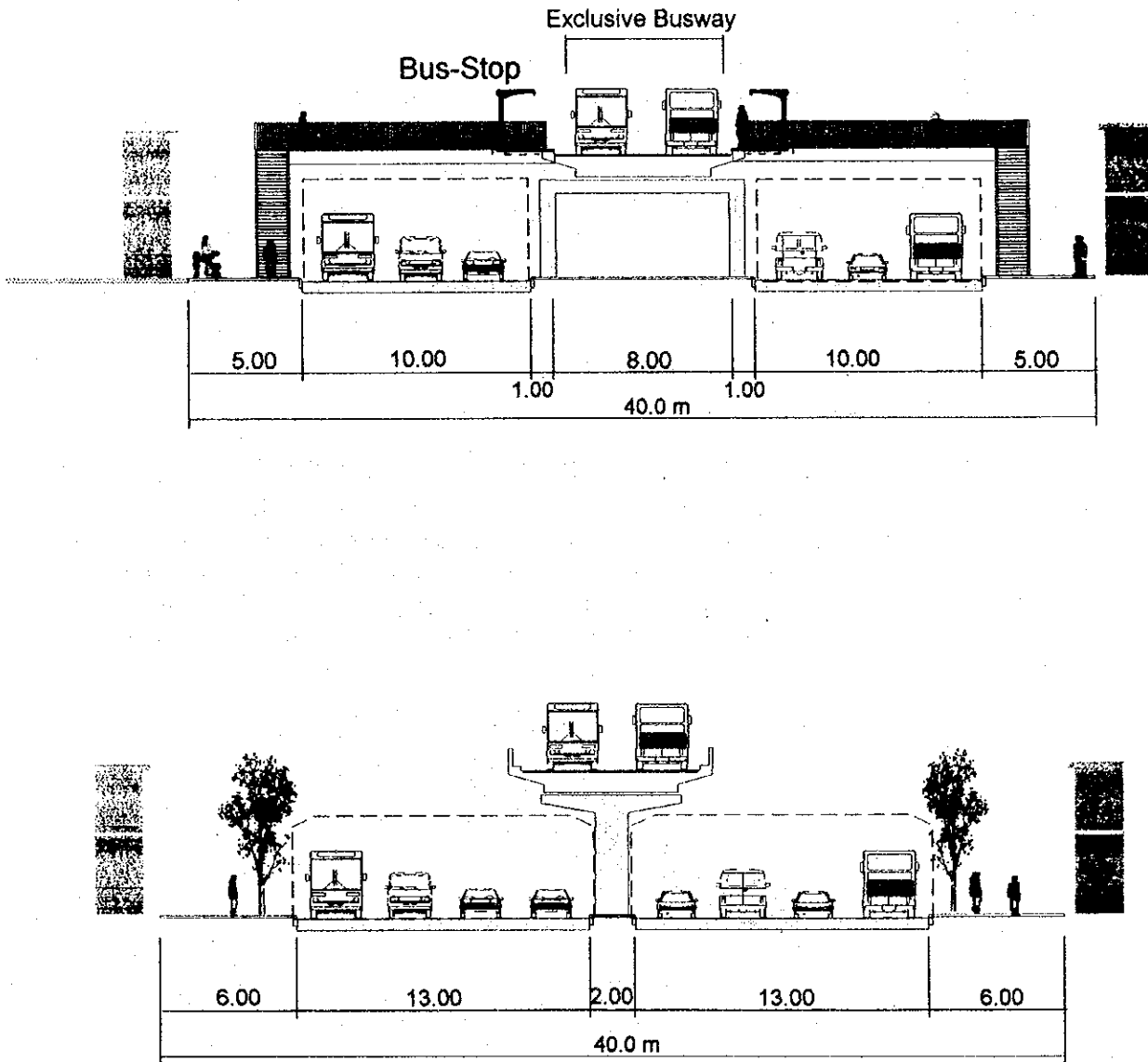


Figure 5.4-19 Elevated Busway – General Arrangement

## (2) Nodal Facility

### 1) Bus Stop

Bus stop capacity is an important determinant of overall bus system performance. Bus stop appears to limit the capacity of the busway. In many cases, the capacity constraint on a system will be a single bus stop. The interactions between passengers, bus and driver characteristics, and bus stop layout are complex. The capacity is variable and dependent upon passenger behavior, arrival time patterns and many other factors. Bus stop spacing also influences performance.

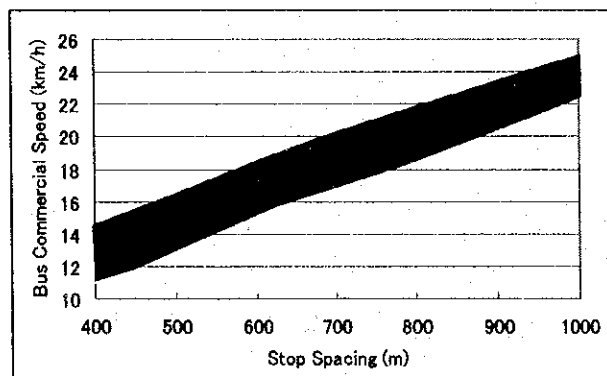
Figure 5.4-20 illustrates the effect of bus stop spacing on bus commercial speed under typical operating conditions. The design of bus stop spacing will be critical in the performance of trunk and feeder bus system.

Traffic behavior at bus stops is extremely complex and relatively little is known about bus stop capacity. Since in Bogota bus passengers mostly board or alight at no bus stop or near a bus stop, actual passenger behavior is more complicated.

In the Study, bus stop design which affect capacity of the system will consider the following:

- the number of bus bays provided
- the order in which buses stop
- facilities for buses to overtake one another (and thus to avoid blockages)

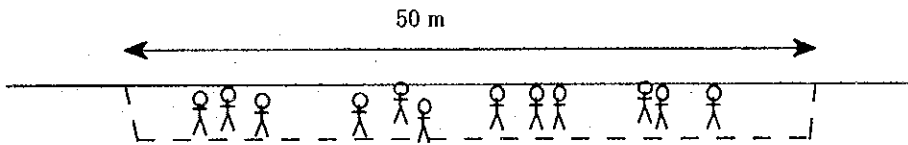
The number of bus bays at each stop on a busway transit system will typically vary, depending on the transfer demand. The bays can be either 'on or off-line'. On-line bays allow no special overtaking facility; the buses stop on the busway track. Off-line bays have a stopping area which is separate from the main running track; as a result buses can easily overtake one another at bus stops. Figure 5.4-21 shows some examples of these design options



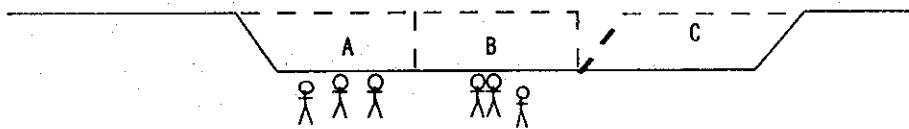
Source: Design Guidelines for Busway Transit (TRL, 1993)

Figure 5.4-20 Relationship Between Bus Stop Spacing and Commercial Speed

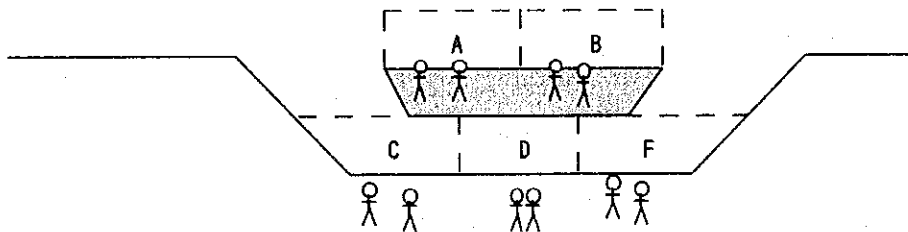
1) 3 on-line bays, random arrivals



2) Off-line bays with overtaking: Bay C provided at all stops or only for limited stop express service (Sao Paulo)



3) Special: High capacity parallel bays (Singapore)



Source: TRL,1993

Figure 5.4-21 Some Examples of Bus Bay Layouts

## 2) *Bus Terminal*

The essence of a city center is that it is the most accessible point from both within and without the city. This accessibility is important for many activities, and in particular for those central functions of business, commercial, and central governmental offices. In Bogota, the majority of commuters to /from the center depend almost exclusively on road-based public transport. The public transport system should provide adequately to support these central functions.

In order to maintain the vital relationship between the well-being of the city center and its public transport system, a central bus terminal should be located in the city center. The central bus terminal should have a function which serves as a major transfer and transport connection point between private and public transports including metro line with brief shopping complex.

### 5.4.8. ORGANIZATION AND MANAGEMENT

In order to develop a busway transit system which can offer high performance, special operational measures are required. Some measures necessitate suitable organizational and management arrangements in order to be effective.

#### (1) Transmilenio Project

Figure 5.4-22 shows the current management system and STT's plan in TRANSMILENIO. The function of new organization in TRANSMILENIO under planning shows the following:

##### 1) STT, Authority

- General policy of the system
- General planning of the system
- Regulation
- TRANSMILENIO supervisor
- Management of the actual system

##### 2) TRANSMILENIO Company

- Renting service contract
- Renting service control
- Tariff charge
- Pay for the renting service
- Terminal commercialization

##### 3) Private Company

- Buy buses
- Bus maintenance
- Contract drivers
- Garage operation
- Rent the service on the routes

## (2) Third Sector/ Public Corporation

In this method, the state, city, private companies and/or banks share the capital investment to establish an enterprise to operate public transport projects. A company manages and operates itself by project income. In Japan, some bus, railway, highway and urban development projects are operated by such organizations.

Public corporations are usually under the supervision of the state or city and operate by subsidies or income from the project. In Japan, some railways, metropolitan expressway, inter-city highway, and regional turnpikes are operated, maintained, and managed by such organizations.

In the organization and management of public transportation, the following functions are indispensable in order to be effective.

- Management of the bus track
- Maintenance of the bus track, bus stop facilities and traffic control devices
- Fare collection and ticketing

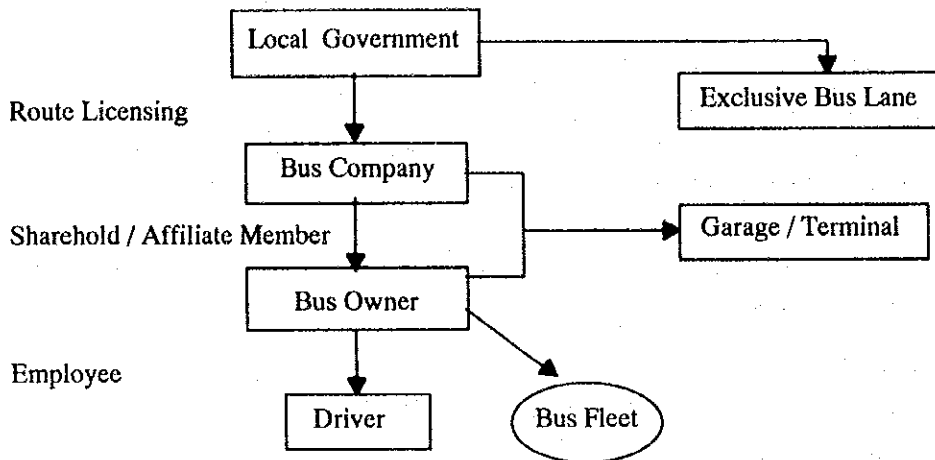
### 5.4.9. EVALUATION ITEMS FOR TRUNK BUS SYSTEM

According to Person Trip survey, approximately 80% of the total trips are by public transport users in Bogota. The public transport is predominant in volume and its role. It is necessary to conduct evaluation comprehensively. Therefore the evaluation of trunk bus system is conducted not only by economic and financial evaluation, but also evaluation from view points of bus passengers, private car users and environment as shown in Figure 5.4-23.

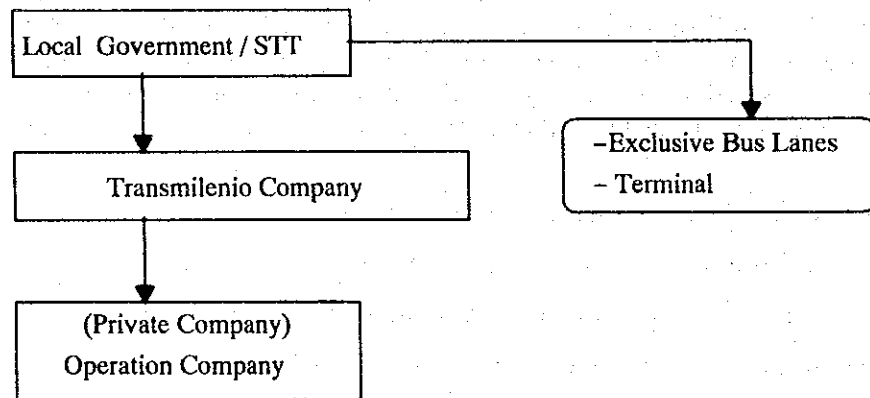
The evaluation items and their components are as followings:

- 1) Administration: economic evaluation, average congestion ratio
- 2) Operator: financial evaluation, impact on current system
- 3) Public Transport Passengers: travel time, travel cost
- 4) Private Car Users: travel time, travel distance
- 5) Environment: impact on commercial activity, noise / air pollution

Current System



STT's Plan



Third Sector

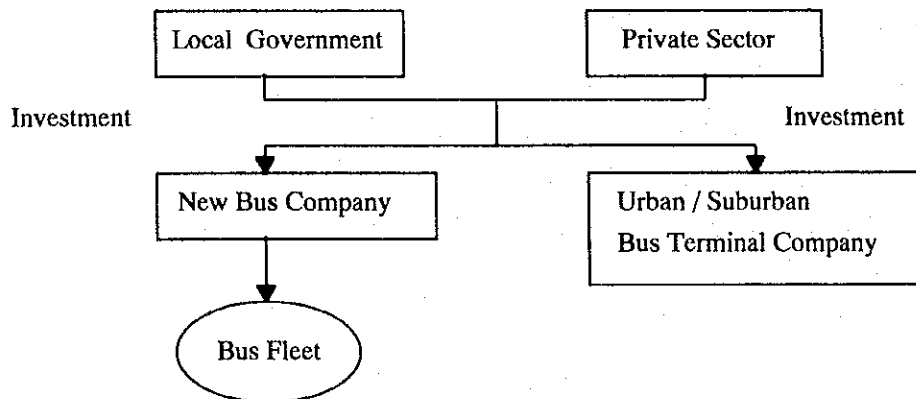


Figure 5.4-22 Management and Operation System

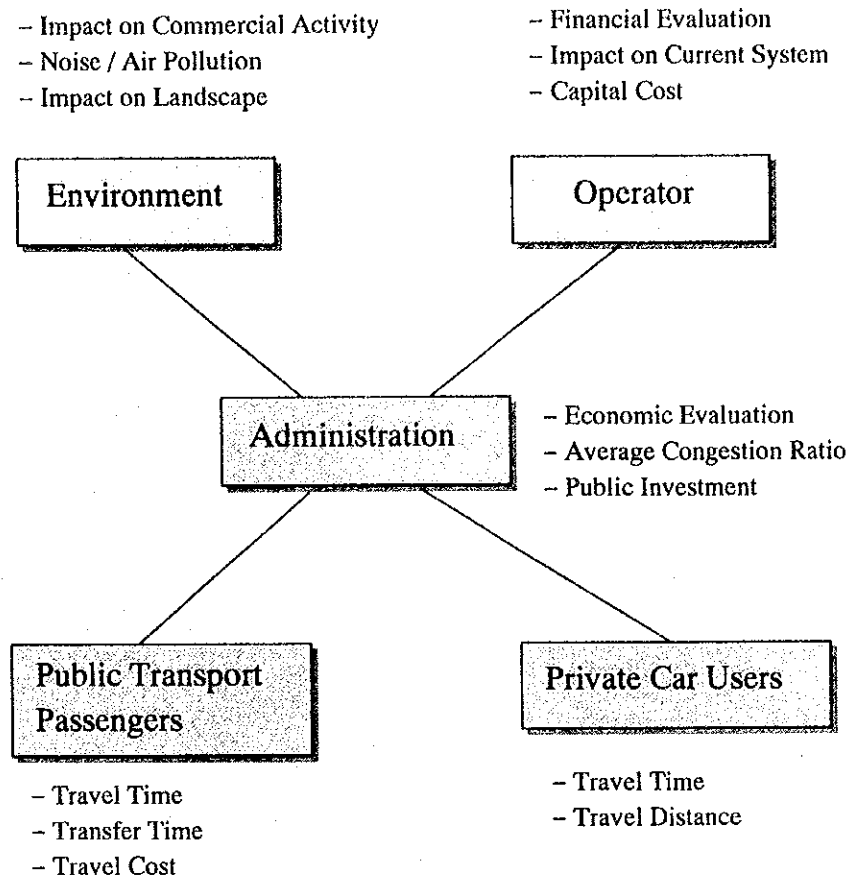


Figure 5.4-23 Evaluation of Trunk Bus System

#### 5.4.10. OTHER PLANNING ISSUES

It is not easy to introduce the trunk bus system in Bogota where many bus companies operate bus transport with approximately 850 bus routes and approximately 20,000 buses under the current bus operation system. When the current bus system will be replaced to trunk bus system, many issues will occur such as rerouting of bus routes, renewal of old bus fleet, operation of trunk and feeder buses, etc.

Therefore, the following issues shall be evaluated in the course of the study.

- 1) Integration or adjustment of existing bus route.
- 2) Inter-city buses to / from adjacent cities.
- 3) Express bus / non stop bus service.
- 4) Conversion from private mode use to trunk bus or railway use.
- 5) Renewal or elimination of super-old fleet.
- 6) Operation system of bus terminal.
- 7) Institutional reorganization for new bus system.
- 8) Financial scheme of trunk bus project.
- 9) Redistribution of proceeds (Shared Revenue).



