EXPLORING THE PROVISION OF EXPRESS BUS SERVICE IN METRO MANILA

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Abstract: This study explored the possibility of providing express bus service in Metro Manila during the morning and afternoon peak periods. Data on passenger demand of buses during peak periods showed that it is possible to provide a *one-to-one* (or *point-to-point*), *one-to-many*, and *many-to-many* type of express bus service to particular routes. By dividing the routes into segments, an express type of service is possible when a high percentage of embarking passenger from the origin terminal or first (and second) segment disembark on the end terminal or the last (or last two) segment. Segments in between could then be skipped thus improving travel time without affecting bus revenues.

1. INTRODUCTION

Several developments are occurring in Metro Manila that make the area conducive to the application of express bus services. Metro Manila is characterized by a high daytime population and a lower nighttime population. The rapid expansion of its peripheries which are mostly developed for residential areas has resulted in the heavy influx of urban commuters from these peripheries towards the urban centers in the morning and the reverse phenomenon, i.e. heavy traffic from the urban centers to the peripheries, occurs in the afternoon.

The efficiency of the "democratic" way of providing public transport on Metro Manila streets is largely perceived to be contestable. In the spirit of *laissez faire* competition, any public transport mode can provide service along any Metro Manila street. As a matter of policy, several government measures govern the number and type of public transport mode that can provide service along a particular route. In practice, however, these measures are hardly complied with. For bus public transport, "democratic" also means that bus operators give their bus drivers the freedom of deciding when to dispatch the buses. This results in buses routinely competing for passengers at bus stops, even among buses operated by a single company. Given this situation, repercussions on the local traffic situation and the adjoining transport system could be any or a combination of the following:

1. Local congestion in certain areas attributed to the aggregation of buses at bus stops. As buses outmaneuver each other to get passengers, adjacent lanes are blocked thereby causing disruption to adjacent vehicle flow;
2. The incidence of traffic-related accidents rises as a result of this driving behavior, causing long queues on the affected segment of the highway whenever accidents occur;

3. Since competing buses usually stake each other out at the start of the journey, so that when one starts its service, all the other buses would also start their own. The net result is bunching of buses, which causes longer waiting time and inconvenience for the bus-riding public.

The introduction of the Light Railway Transit (LRT) 3 along the Epifanio de los Santos Avenue (EDSA) will most likely displace the traditional service route of most bus companies, especially if their operating characteristics would remain the same.

Hence, it is important to explore the possibility of changing the type of service that is currently being provided to bus commuters. It is then necessary to determine the characteristics of bus routes favorable to bus express service. Bus express service here means that buses currently serving a particular route can provide non-stop service at some portions of the route, usually the middle portions, to improve travel movement. This study would like to put forward four types of bus express service configuration and these are shown in Figure 1; namely, *point-to-point*, *one-to-many*, *many-to-one*, and *many-to-many* bus express service.

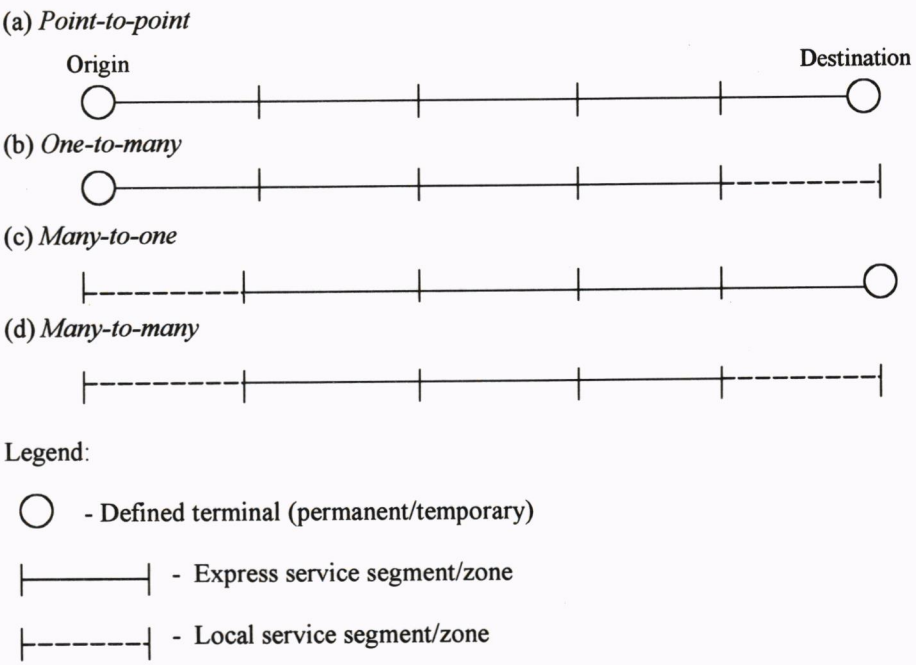

Figure 1. Types of Express Bus Service

Bus express service being discussed here has some similarities to the zonal express service of Furth (1986) and zone scheduling by Turnquist (1979). Bus express service has several advantages as distinguished from the local type of service: (1) Since a portion of the bus trip is made non-stop, travel time is reduced for users originating from or destined for the point at the end of the route; (2) Empty seats are reduced in buses, the operator enjoys increased productivity from his vehicles and drivers; and (3) The collection of higher fares since most trips are from end to end, thereby increasing revenues.

On the other hand, bus express service also has some disadvantages, namely: (1) Trips originating along the express segment would have more waiting time since frequency of service for local operation will be reduced; and (2) There may be longer waiting time at the origin terminal to fill the bus with passengers, or longer delay may be experienced along the initial segment(s) when buses collect passengers.

This study uses a simple process of determining whether express bus service can be provided on a given bus route using passenger demand as basis. By obtaining the percentage distribution of embarking and disembarking passengers on each segment, the corresponding bus route will be considered for express bus service if and when: (a) the difference of embarking minus disembarking (E – D) passengers on the first segment is at least 50 percent; and (b) the difference of disembarking minus embarking (D – E) passengers on the last segment is at least 50 percent. If a certain route does not qualify under these criteria, we can further consider the (E – D) passengers on the first and second segments and/or the (D – E) passengers on the last two segments. When a bus route qualifies, this will then be checked whether it is using a terminal at either end. Those without terminals at either end are considered directly under the *many-to-many* type of express service. Those with terminals can either qualify under *one-to-many*, *many-to-one* or *many-to-many* types of express bus service.

2. BACKGROUND

This study will not search for the optimal bus network configuration for Metro Manila. What is being explored here is whether we can provide express bus service during the peak hour periods (morning and afternoon) on the existing bus routes serving the metropolis by solely considering the existing bus passenger demand along each individual bus route. Express bus service here, as differentiated from the local type of bus service, means that in some portions (usually the middle segments) of the existing bus route, the bus can run non-stop. Jordan and Turnquist (1979) termed this as zone scheduling, which is useful when a large majority of bus route passengers from all stops in a zone are bound for (or originate from) one stop (usually the CBD). They also termed this as *many-to-one* or *one-to-many* type of service. Several studies have been conducted to optimize bus service operation using similar network configuration: Byrne (1975), Tsao and Schonfeld (1983), Turnquist (1979), Wirasinghe (1980), Clarens and Hurdle (1975), Furth (1986).

Aside from these two types of express service, a *one-to-one* (or *point-to-point*) type of express service could also be provided wherein buses from an origin terminal in one CBD can run non-stop to an end terminal in another CBD. This is particularly applicable in the case of Metro Manila where several CBDs coexist. Another type is the *many-to-many* type of express bus service. Chang (1991) discussed the *many-to-many* type of bus service which caters to multiple stops throughout the bus route. This is also similar to the multiple origin-multiple destination trip distribution of Newell (1979) where he discussed some issues relating to the design of minimum cost bus routes. Chang and Newell may also be referring to the local type of bus service where all bus stops are being serviced to pick up and drop off passengers. The *many-to-many* express bus service being put forward here is somewhat different since multiple stops occur only in the initial segment(s) and along the end segment(s) while middle segments are being skipped.

3. METHODOLOGY

Since the objective of this study is to determine the potential of applying the four types of express bus service to bus operation in Metro Manila, it is then necessary to understand the daily travel pattern of urban commuters in the metropolis. The Metro Manila Transport Integration Study (MMUTIS) (1998) produced a good estimate of trips generated and attracted to each and every component city and municipality of Metro Manila. The MMUTIS pointed out that 14.9 percent of daily person trips used the bus public transport in 1996. The extent of bus service routes observed in this study is shown in Figure 2.

To focus on these bus users, (Figure 3) it is then important to understand their travel behavior. The bus passenger movement during the peak morning and afternoon hours of the working days was observed along selected routes. Bus samples were taken on field by actually riding buses at random, commencing from trip starts until destination points. This method made it possible for researchers to cover the entire route.

During the entire trip, the number of all embarking and disembarking bus passengers was systematically recorded. Also noted were total travel times, the seating capacity of the bus, extent of over-capacity (on the basis of standing passengers), causes of delay at points of stalling, and the type of land use along the route.

The observed bus routes were divided into five to eight segments using two general criteria:

1. *General land use type of the segment.* It is sometimes difficult to give an exact land use classification for some areas because of the mixed land use development activities present along the route being serviced by the bus. However, there are distinguishing factors that aided the classification process, such as infrastructure facilities along the road, the presence/absence of human activities and the presence of other vehicle types; and
2. *Road classification and geometry.* These were obtained through ocular inspection and from street signs posted on the roadside. The data were also verified from the classification list of the Department of Public Works and Highways (DPWH)-National Capital Region, Metro Manila.

After each bus route was divided into segments using the abovementioned criteria, the number of embarking and disembarking passengers on each segment was obtained. The percentage distributions of embarking and disembarking passengers on each segment of the bus route were then computed. An express type of service is effective when a group of passengers coming from a common origin is going to a common destination. It is then convenient to skip some portions of the route, especially the middle segment(s) to minimize delay. Because bus operation in Metro Manila is not subsidized, the only source of bus revenue is from bus passenger fares. Hence, there is a hypothetical number of passengers per bus per route that the bus operators has to achieve to break even with bus operating costs for that time of day (morning and afternoon peak periods). For lack of a good data estimate on this, the following guide will be used: A particular bus route will be considered for express bus service if and when (a) the difference of embarking minus disembarking (E – D) passengers on the first segment is at least 50 percent; and (b) the difference of disembarking minus embarking (D – E) passengers on the last segment is at least 50 percent.

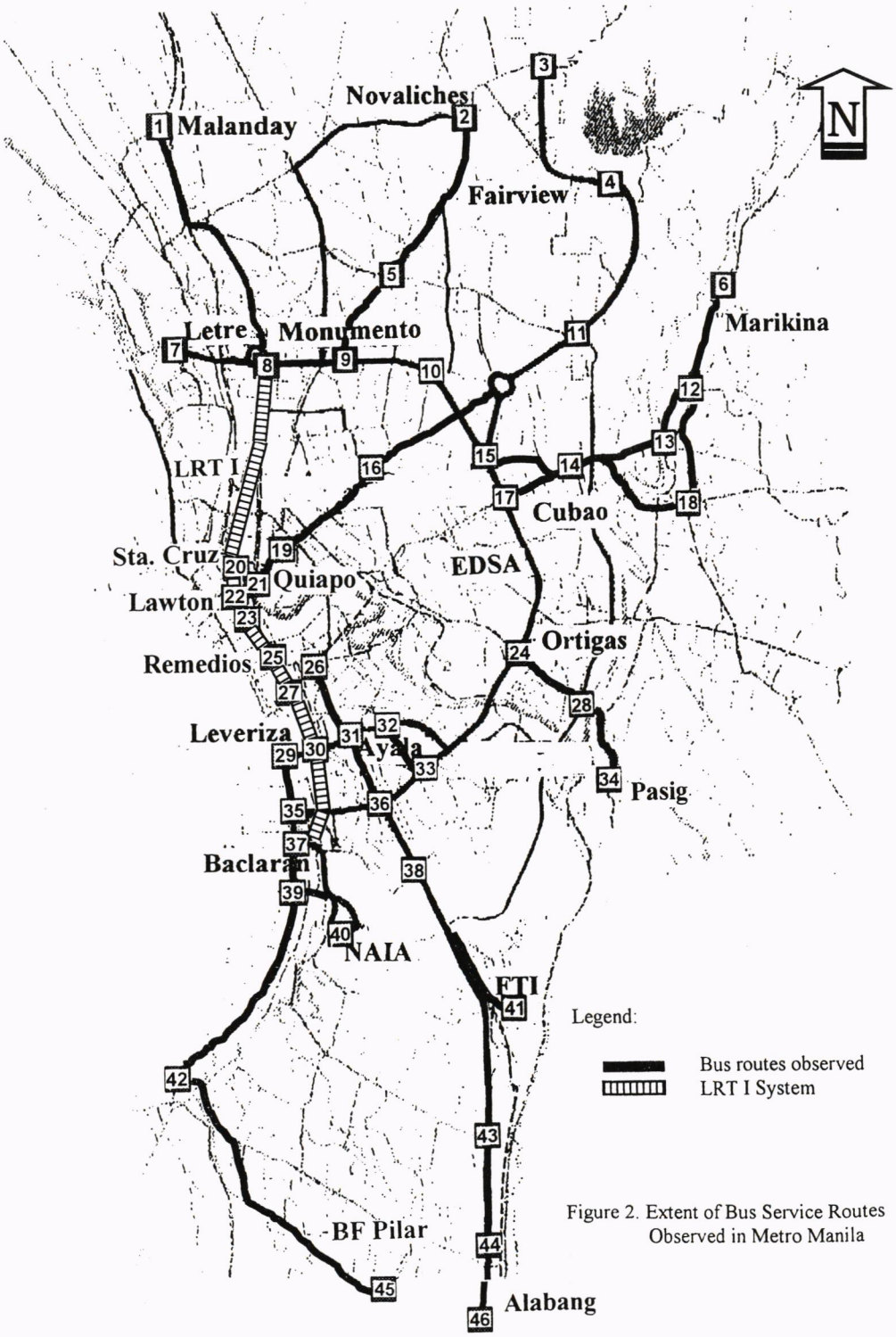

Figure 2. Extent of Bus Service Routes Observed in Metro Manila

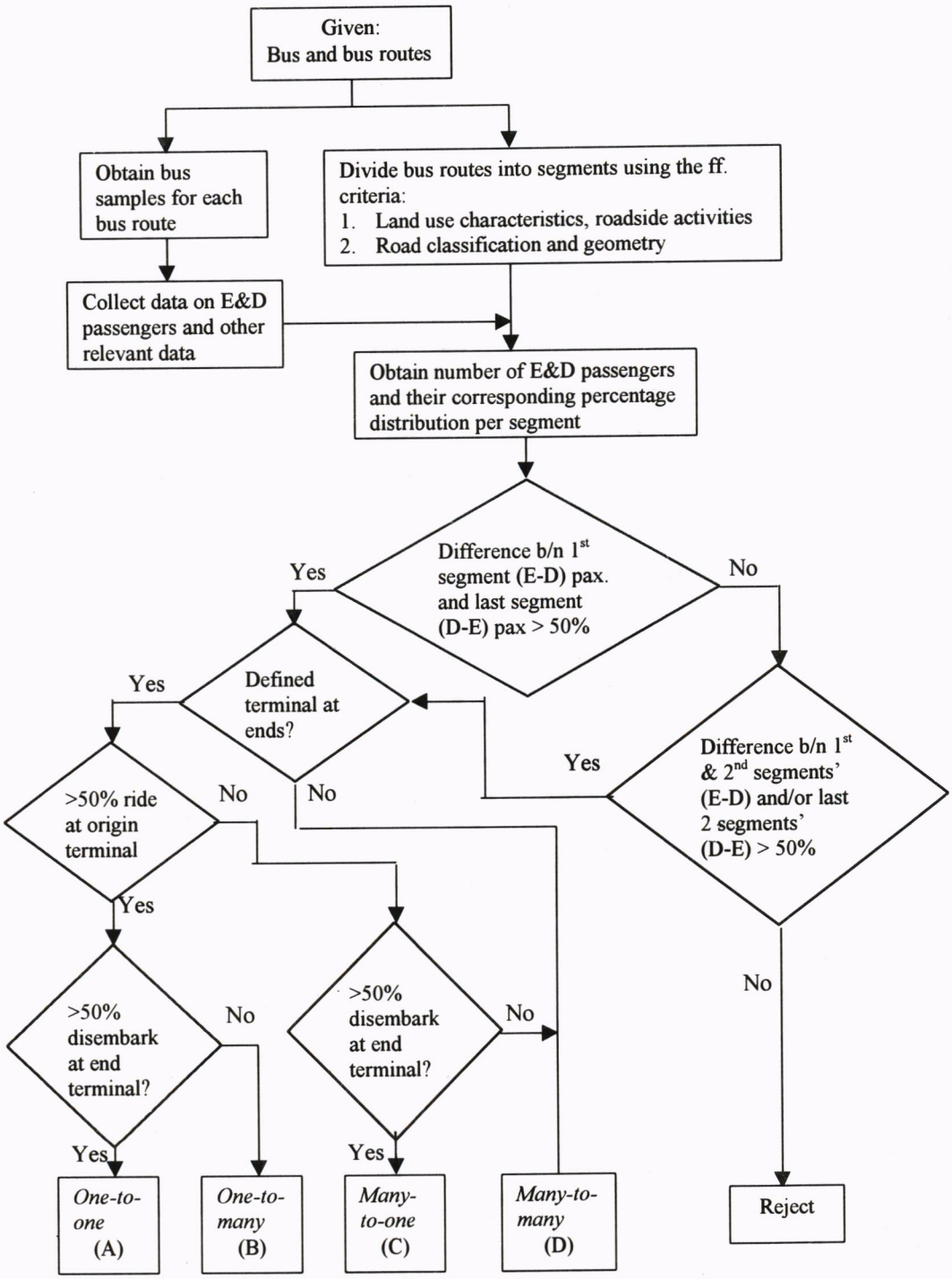

Figure 3. Flowchart Used in Deciding the Type of Express Bus Service

However, if a certain route does not qualify under these criteria, we can further consider the (E – D) passengers on the first and second segments and/or the (D – E) passengers on the last two segments. This would hold if the length of the middle segment(s) which is to be skipped is equal to or greater than the sum of the segments where local service was provided. This was done so that at least half of the bus route would be under express bus service. The bus route that qualifies will then be checked whether it is using a terminal, temporary or permanent, at either end. Those without terminals at either end are considered directly under the *many-to-many* type of express service.

For those with terminals, if at least 50 percent of all embarkation on the first (and second) segment occurs at the origin terminal but less than 50 percent of the last (or last two) segment passengers disembark at the end terminal, a *one-to-many* type of service can be considered. However, if at least 50 percent of all disembarkation at the last (or last two) segment occur at the end terminal, a *one-to-one* type of service could be provided. If less than 50 percent of all embarkation at the first (and second) segment occur at the origin terminal but at least 50 percent of all disembarkation at the last (or last two) segment occur at the end terminal, a *many-to-one* type of service could be provided. Otherwise, a *many-to-many* type of bus service is to be considered.

So far only the general pattern of embarking and disembarking passengers on a particular bus route is known, while the exact embarking and disembarking locations of individual commuters are not exactly known. Although the criteria developed assure that majority of embarkation occur at the first (and second) segment, as well as majority of disembarkation occurs at the last (or last two) segment, it is still necessary to determine the exact origins and destinations of passengers along the bus route so that the travel movement of bus commuters during rush hours can be reasonably explained. To determine this objective, bus passengers originating at the terminal or on the first segment were sampled to determine their destinations.

The bus sampling was done from July 1998 to June 1999, and not much variation in bus operation was observed during this period. There is normalcy in bus operation since bus operators and drivers work on a daily basis.

4. THE PUBLIC BUS TRANSIT OPERATION IN METRO MANILA

The public utility buses (PUBs) operating in Metro Manila are mostly imported second-hand from neighboring Asian countries. The buses are of single-door types for air-conditioned units and two-door types for non-air-conditioned units. The seating capacity of buses surveyed ranged from 46 to 66, with seats arranged in fours or fives in a row, facing the direction of motion, and with an alley along the middle. Modifications are sometimes made in this seating arrangement, like the removal of some of the seats near the door to improve movement of entering and exiting passengers, and also to provide space for standing passengers. A conductor inside the bus collects bus fares.

The major road system of Metro Manila was designed to go radially with the City of Manila as the focal point. EDSA, the so-called lifeline of the transport system in the metropolis, is where most of the urban bus service is concentrated due to the existence of nascent CBDs like the Ayala and Ortigas along this route. Most buses follow the same line

they previously traverse on the return trip. Only when a one-way street system is encountered do they deviate from their original route.

Buses providing service in Metro Manila starts to service their route on any of the following: a) from their privately owned terminal with limited amenities; b) from service area of gasoline stations; or c) simply waiting at the road side for passengers. The current type of service they provide could be considered as *local bus service* since all stops along a given route are being served. Buses even stop on areas not identified as bus stops to pick up or drop off passengers. Identified major bus stops are usually situated in the middle of a street block (like in the Ayala CBD), on the near side or far side of an intersection, near pedestrian overpasses, or at locations where there are major activity centers like shopping malls. All bus stops are adjacent to the curb for direct or easy access of passengers, although no provisions are provided for people on wheelchairs to enable them to ride a bus.

5. DATA AND ANALYSIS

As the MMUTIS (1998) results showed, the concentration of trips in the morning occurs between 6:00 to 9:00 in the morning and 4:00 to 7:00 in the afternoon. Hence, bus samples were obtained during these periods and the critical passenger movements were observed.

5.1 Proportion of Embarking and Disembarking Passengers along Bus Routes

After each bus route was divided into segments using the simple criteria mentioned, the proportion of embarking and disembarking passengers segment-wise was obtained. High percentages of embarking passengers at the first segment and disembarking passengers at the last segment would mean a good candidate for the proposal being undertaken. Of course, in addition, there should also be fewer disembarking passengers at the first segment and still fewer embarking passengers at the last segment, to show that a particular route caters to long haul passengers.

Table 1 shows these percentages for all the bus routes sampled with the percentages of embarking and disembarking passengers for the first and last segments. The percentages of embarking and disembarking on the middle segments are not shown in this table. Blank slots signify that there was no bus service being provided on that particular route during the study period.

To relate Table 1 with Figure 2, Table 2 provides the numbered routes of the buses in the map and the corresponding estimated length of the bus route obtained from a scaled map. To minimize article space, bus routes will now be referred to by their origin and end numbered nodes. For example, for Sta. Cruz to BF Pilar route shall be labeled as Route *20-45*. Bus routes in the opposite direction follow the same route unless stated otherwise.

Table 1. Percentages of E & D Passengers on the First and Last Segments of Bus Routes

Bus Routes	1st Segment				Last Segment			
	Embark(%)		Disembark(%)		Embark(%)		Disembark(%)	
	AM	PM	AM	PM	AM	PM	AM	PM
BF Pilar to Sta. Cruz	79.15	71.03	8.19	12.50	0.00	0.00	21.46	26.14
Sta. Cruz to BF Pilar	13.25	33.17	0.00	0.00	6.06	4.01	62.46	72.57
Novaliches to Ayala	61.65	61.11	1.50	20.37	0.00	0.00	28.57	20.37
Ayala to Novaliches	4.26	37.50	0.00	0.00	9.57	5.88	54.26	52.21
Remedios to Fairview	47.92	32.29	0.36	0.96	0.36	9.14	24.39	38.13
Fairview to Remedios	59.26	11.25	0.57	0.00	0.00	0.00	31.2	42.61
Monumento to Leveriza	48.30	22.50	7.92	8.33	4.34	15.00	15.01	53.33
Leveriza to Monumento	40.49	20.40	8.58	2.69	3.89	11.29	33.99	33.32
Fairview to NAIA	8.74	8.91	0.00	0.00	0.00	0.00	8.74	16.83
NAIA to Fairview	16.67	16.05	3.85	0.65	0.00	0.28	1.28	9.06
Letre to NAIA	40.59	24.09	0.00	2.92	0.91	0.73	10.17	13.87
NAIA to Letre	15.24	10.40	0.00	0.00	0.00	0.00	10.48	16.80
Pasig to Leveriza	84.62	-	1.92	-	0.00	-	19.23	-
Leveriza to Pasig	-	49.42	-	3.98	-	4.38	-	63.42
Monumento to Baclaran	57.30	15.79	17.98	7.89	0.00	0.00	7.30	17.11
Baclaran to Monumento	29.29	13.18	0.00	0.00	5.05	8.53	19.19	35.66
Quiapo to Ayala	90.77	83.67	0.00	3.40	0.47	1.02	49.73	48.64
Ayala to Quiapo	62.34	-	1.01	-	0.00	-	28.33	-
Lawton to Alabang	84.98	99.44	0.00	0.00	0.00	0.00	84.88	98.27
Alabang to Lawton	93.15	87.84	0.00	0.00	0.00	0.00	42.04	44.92
Malanday to NAIA	53.62	37.50	4.89	2.72	0.55	0.00	22.80	15.76
NAIA to Malanday	47.83	35.49	2.91	1.73	0.72	10.49	21.74	35.47
Letre to Leveriza	30.55	27.83	0.51	1.74	0.60	2.61	18.28	34.35
Leveriza to Letre	38.74	21.67	11.71	1.93	1.80	0.78	20.72	26.66
Leveriza to Malanday	12.04	14.55	2.31	0.00	0.46	0.68	18.06	19.97
Malanday to Leveriza	34.19	39.25	0.85	0.93	0.00	0.00	25.64	20.56
Alabang to Novaliches	-	6.90	-	0.00	-	4.72	-	36.04
Novaliches to Alabang	17.50	26.02	0.00	5.61	0.00	0.00	7.50	28.06
Leveriza to Fairview	79.35	18.85	13.04	1.05	0.00	2.42	10.87	32.25
Fairview to Leveriza	7.50	10.71	0.91	0.00	0.44	11.85	8.55	50.44
Letre to Baclaran	19.37	5.75	0.32	3.90	0.00	7.78	16.51	21.70
Baclaran to Letre	12.68	3.75	0.00	0.42	0.00	0.83	16.90	21.95
LRT to Marikina	55.49	35.92	13.29	9.92	0.00	2.95	10.41	24.66
Marikina to LRT	40.88	8.78	8.76	0.00	4.38	19.59	26.28	52.70
Alabang to Fairview	50.00	26.85	2.04	0.00	0.00	0.00	4.08	16.11
Fairview to Alabang	18.06	10.29	0.00	0.00	0.00	0.00	2.78	70.59
Fairview to Baclaran	13.64	5.00	0.00	0.00	0.00	0.00	3.79	22.00
Baclaran to Fairview	15.60	3.73	0.00	0.00	0.00	0.00	13.76	28.36
Malanday to Alabang	57.38	11.77	9.01	0.00	0.00	0.00	9.02	44.12
Alabang to Malanday	47.37	20.99	1.50	0.00	1.50	1.85	39.85	31.48
Alabang to Letre	50.40	30.43	4.80	0.45	0.00	0.99	8.00	39.62
Letre to Alabang	52.11	24.27	0.00	0.00	0.00	0.00	9.86	23.30
Monumento to FTI	87.14	16.15	8.57	3.85	0.72	0.00	10.72	73.07
FTI to Monumento	17.37	71.08	0.53	0.00	0.00	0.00	23.16	21.69

Table 2. Corresponding Numbered Bus Routes and Lengths

Bus Route Name	Numbered Bus Routes	Length(km)
Sta. Cruz to BF Pilar	*20-23-30-29-39-42-45*	26.170
Novaliches to Ayala	*2-5-9-10-17-24-33-32*	23.980
Remedios to Fairview	*25-21-19-16-11-4*	20.390
Monumento to Leveriza	*8-10-17-24-33-32-29*	21.615
Fairview to NAIA	*4-11-15-17-24-33-35-39-40*	35.110
NAIA to Fairview	*40-37-35-33-24-17-15-11-4*	33.420
Letre to NAIA	*7-8-10-17-24-33-35-39-40*	27.450
Leveriza to Pasig	*29-32-33-24-28-34*	13.920
Monumento to Baclaran	*8-10-17-24-33-35-37*	22.070
Quiapo to Ayala	*19-21-26-31-32-33*	10.140
Lawton to Alabang	*22-25-26-31-36-43-46*	20.650
Malanday to NAIA	*1-8-10-17-24-33-35-39-40*	33.750
Letre to Leveriza	*7-8-10-17-24-33-32-29*	24.170
Malanday to Leveriza	*1-8-10-17-24-33-32-29*	29.510
Novaliches to Alabang	*2-5-9-10-17-24-33-36-43-44-46*	36.860
Fairview to Leveriza	*3-4-11-15-17-24-33-32-29*	28.460
Letre to Baclaran	*7-8-10-17-24-33-35-37*	24.650
Marikina to Leveriza	*6-12-13-14-15-17-24-33-32-29*	26.115
Leveriza to Marikina	*29-32-33-24-17-14-18-12-6*	28.935
Fairview to Alabang	*4-11-15-17-24-33-36-43-44-46*	35.055
Fairview to Baclaran	*4-11-15-17-24-33-35-37*	27.305
Malanday to Alabang	*1-8-10-17-24-33-36-43-44-46*	39.440
Letre to Alabang	*7-8-10-17-24-33-36-43-44-46*	34.330
Monumento to FTI	*8-10-17-24-33-36-38-41*	27.960

Table 3 below shows the bus routes that passed the initial criteria used.

Table 3. List of Bus Routes Passing the Initial Criteria

Bus Route	1st Segment Net of (E – D) In Percent	Last Segment Net of (D – E) In Percent
22-46 (AM Peak)	84.98	84.88
22-46 (PM Peak)	99.44	98.27
19-33 (AM Peak)	90.77	49.26

However, we could further segregate the first two segments and/or the last two segments to see whether an increase in the proportion of embarking in the former as well as disembarking in the latter would result. The choice of a bus route for the application of this process will depend on the related characteristics of the adjoining first two and last two segments. If these segments have similar land use patterns, roadside activities, and roadway geometry and also similar bus operating behavior along these segments, then the bus routes would be considered.

Table 4 shows the bus routes where the first and second segments could cater to local service and run express along the middle segment(s) up to the start of the last segment

where local service can again be provided. Although Route *22-46* (both morning and afternoon peak periods) was already considered previously, its local service could still be extended to the second segment, which is largely a residential area, before running express along the South Luzon expressway going to the last segment. Routes *20-45* (both morning and afternoon peak periods) and *29-34* (afternoon peak period) are also considered. The former has the new coastal road expressway as part of its middle segment, while the latter has EDSA as part of its middle segment.

Table 4. Percentages of Embarking and Disembarking Passengers on the First Two and Last Segments

Bus Routes	In Percent							
	1st and 2nd Segments				Last Segment			
	Embark		Disembark		Embark		Disembark	
	AM	PM	AM	PM	AM	PM	AM	PM
20-45	64.80	75.97	4.63	3.94	6.06	4.01	62.46	72.57
22-46	94.07	100.00	0.00	0.00	0.00	0.00	84.88	98.27
29-34	-	73.45	-	10.20	-	4.38	-	63.42

While Table 5 presents the bus routes whose first and last two segments cater to local service with the possibility of providing express service along the middle segments. Take note that the reverse routes of those considered in Table 4 are all considered under Table 5. This may show that bus commuters along these routes use the bus mode both ways on a more or less regular basis. Route *19-33* (mornng peak period) was previously considered under Table 2 but the proportion of (D – E) passengers along the last two segments could be further improved. At the same time, its afternoon peak period was also considered under this analysis. In this route, the second to the last segment is already becoming similar to the Ayala CBD with several high-rise buildings in place.

Table 5. Percentages of E & D Passengers on the First and Last Two Segments

Bus Routes	In Percent							
	1st Segment				Last 2 Segments			
	Embark		Disembark		Embark		Disembark	
	AM	PM	AM	PM	AM	PM	AM	PM
45-20	79.15	71.03	8.19	12.50	6.90	9.66	54.63	55.12
34-29	84.62	-	1.92	-	0.96	-	52.88	-
19-33	90.77	83.67	0.00	3.40	1.43	7.48	90.61	78.23
46-22	93.15	87.84	0.00	0.00	0.00	0.00	79.01	70.68

No bus route was considered under the greater than 50 percent proportion of (E – D) passengers on the first and second segments and greater than 50 percent proportion of (D – E) passengers on the last two segments.

Other observations made on the bus routes and passenger demand characteristics are presented below:

1. Bus routes where express bus service could be applied have expressways or major arterial roads as middle segments where passenger embarking and disembarking

seldom occur. Hence, passengers coming from the first (and second) segment are most likely bound to disembark after these expressways or major arterial roads.

2. No direct competition from other modes is present along these chosen bus routes. A passenger has to make several transfers using other or a combination of modes in order to reach his/her destination in either direction.
3. Most of those bus routes that did not pass the criteria are using EDSA. Although buses coming from the peripheries in the morning are fully occupied, most of these bus commuters disembark along EDSA while additional embarkation along EDSA occur whose destinations are the end segments. For buses using EDSA, very negligible "end-to-end" passengers are catered to.
4. The presence of the LRT I system from Monumento to Baclaran gives the riding public going towards the north-south direction a choice to skip EDSA, especially going to Manila and the Makati CBD in the morning, which are the two biggest generators of trips identified in the MMUTIS (1998). The opposite direction may also be true in the afternoon. (Please see Figure 2 for the LRT 1 route.) Aside from being cheaper than buses when considering the whole length of travel, using the LRT I system is also at least four times faster. This deprives buses going in the north-south direction of long haul passengers as manifested by the data.
5. For areas in the northwest section of Metro Manila such as Novaliches, Fairview and Marikina, the major competitor of buses plying these routes is the jeepney mode. Although jeepneys cannot use the whole section of EDSA when going south in the morning peak period, or any period for that matter, jeepney routes cut across the Metropolis going towards the general direction of Manila and on to the Baclaran area. These routes are traditional jeepney routes. Other jeepney routes coming from these areas in the morning end in Cubao area, which is the heart of the Metropolis. This is where mode shift occurs, usually from jeepney to bus. This is one reason for the additional embarkation of bus passengers along EDSA. One can then go south or north from Cubao using the bus. The opposite is also true in the afternoon. The new *megataxis*, with a capacity of 10 passengers, that operates like a jeepney (although airconditioned) also poses a threat along these routes.
6. The convergence of buses coming from all directions into EDSA and the presence of several bus operators whose drivers compete with each other for passengers, make the competition along the stretch of EDSA very fierce. This behavior leads to negative effects on all involved. For the passengers, in-motion delay due to bus interaction with other buses and other vehicles especially near bus stops and also when waiting for passengers near major activity centers occur. The bus drivers' behavior of wanting to be the first to arrive on the next major bus stop sometimes lead to accidents leading to major passenger injuries or loss of life. For the bus operators and drivers, extreme bus motion of acceleration and deceleration may lead to engine and bus body fatigue that could translate to high bus operating cost. High maintenance cost and frequent disruption in bus operation, given their second-hand condition, will result in less revenues for both. Accidents may lead to major injuries or death to the driver and high hospitalization costs for treating injured passengers. Other road users, especially private cars experience bottlenecks near bus stops and sometimes figure in accidents with buses. These incidents further make long-haul bus commuting along EDSA a daily burden.

Given these scenarios, the introduction of the LRT 3 along EDSA will most likely deprive the buses of their traditional passenger demand. Since bus operators are voicing their willingness to compete with LRT 3, their current operating characteristics along EDSA is

not something that will make bus passenger demand remain with them once the LRT 3 is in service. Therefore, innovative bus operational strategies have to be thought of to make bus operation along EDSA competitive.

This exploratory study of providing express bus service along bus routes especially along EDSA is a big step towards that objective. Since the longest stretch of EDSA offers unhampered flow through the use of overpasses and underpasses, this could be exploited by bus companies through the provision of express service. In the morning peak period, by providing local service in the suburbs as is traditionally being done, once reaching EDSA express service is provided, and when entering the CBD or other peripheries in the opposite end, local service can again be provided. The opposite can also be done in the afternoon. The convenience of not making any transfer and more direct service to destination could result, compared to using the LRT 3 system along EDSA where at least two transfer will occur – at both ends – plus the inconvenience of going up and down the stairs of the LRT 3 stations.

The abovementioned strategy will not work in the present setup wherein buses even of the same company compete with each other. Sustained involvement and cooperation among bus operators and drivers along major bus routes is necessary to make the strategy work. Since the current passenger demand along a given route is constant, the transport mode that can provide the most efficient service will prosper.

5.2 Behavior of E & D Passengers on Segments with Local Service

As discussed in the previous section, we need to determine whether the chosen bus routes have a terminal where they wait for bus riding commuters at the start of the journey or at the end where passengers disembark. For some bus companies servicing these routes, there really is no terminal to speak of on both ends of the route. For some, only one end has a terminal. Even then, some make use of the road, a portion of the *plaza*, or bus stops adjacent to malls to wait for passengers at the beginning of the route and let off passengers to similarly mentioned locations at the end. Since passengers get accustomed to these so called "terminals", these will be treated as they are.

The number of passengers embarking on or near the terminal and those along the first (and second) segment but not on or near the terminal, and the number of passengers disembarking on or near the end terminal, as well as those along the last (or last two) segment but not on or near the end terminal, were determined. With three to five samples obtained for each route, the averages are shown in Table 6 below.

The idea here is to determine whether the so-called "terminals" being occupied by the buses to wait for passengers serve as good locations for collecting passengers. If the number of embarking passengers on or near the terminal is greater than 50 percent of all embarkation along the first and/or second segments, and if the number of disembarking passengers on or near the end terminal is greater than 50 percent of all disembarkation on the last (or last two) segment, then a *point-to-point* type of service could be considered for the bus route. If only the embarkation part is true, then a *one-to-many* type of express service can be considered. Similarly, if only the disembarkation part is true, a *many-to-one* type of express service can be considered. If both fail, then a "*many-to-many* type is

considered. The resulting type of express service for the identified bus routes is given in the last column of Table 6.

Table 6. Average Number of E & D Passengers on the First and Last Segments.

Bus Route	Ave. Pax. Embarking on the 1st Segment			Ave. Pax Disembarking on the Last Segment			Type of Service
	On or Near the Terminal	Other -wise	Total	On or Near the Terminal	Other -wise	Total	
22-46 (PM)	55	1	55	55	0	55	A
	Ave. Pax Embarking on the 1st and 2nd Segments			Ave. Pax Disembarking on the Last Segment			
	On or Near the Terminal	Other -wise	Total	On or Near the Terminal	Other -wise	Total	
22-46 (AM)	25	18	43	39	0	39	A
20-45 (AM)	8	29	37	5	29	34	D
20-45 (PM)	26	33	59	13	43	56	D
29-34 (PM)	14	76	90	14	49	63	D
	Ave. Pax Embarking on the 1st Segment			Ave. Pax Disembarking on the Last Two Segments			
	On or Near the Terminal	Other -wise	Total	On or Near the Terminal	Other -wise	Total	
19-33 (AM)	61	1	62	5	56	61	B
19-33 (PM)	12	26	38	11	11	22	D
46-22 (AM)	58	2	60	5	46	51	B
46-22 (PM)	38	1	39	20	13	33	A
34-29 (AM)	23	63	86	7	47	54	D
45-20 (AM)	18	39	57	14	24	38	D

5.3 Estimated Points of Disembarkation of Embarking Passengers from the Initial Segment(s)

The percentages of embarking and disembarking passengers per segment only give an aggregate situation of passenger movement along the route. This is so because even though field data show high percentages of embarkation at the first and disembarkation at the last segments it does not really follow that all those coming from the first segment disembarked on the last segment.

It is then necessary to estimate the actual disembarking behavior of passengers coming from the terminal or the first (and second) segment. To do this, samples of passengers coming from the first segment were obtained and their points of disembarkation were determined. Being exploratory, only two bus routes were tested - one in the morning and one in the afternoon peak periods. These bus routes are Route *19-33* during the morning peak period, considered as *one-to-many* type of express service, and Route *29-34*, considered as *many-to-many* type of express service, during the afternoon peak period. Ten sample runs for each route were obtained. Using passenger counts embarking on the bus, those under multiples of three were chosen as samples.

Bus Route *19-33* was divided into five segments, passenger samples obtained ranged between 14 to 20 individuals of the 62 passengers on the bus as it moved out of the origin terminal. The result showed that the average probability that an individual riding at the origin terminal would disembark at any point along the last two segments is 0.9929. For bus Route *29-34*, a *many-to-many* type of express bus service was being contemplated for the afternoon peak period. At the end of the first two segments, an average of 90 passengers embarked on the bus, but 11 of these passengers disembarked. Hence, an average of 79 is left after the first two segments. Given the average seating capacity of buses on this route to be 52, around 27 passengers were standing after the end of the second segment. For this route, passenger samples ranged from 10 to 18 per run. The average probability that a person embarking on the 1st and 2nd segments would disembark on the last segment is 0.5393.

There is some consistency with regards to the disembarking behavior of passengers in these two routes. Hence express bus service in these bus routes can be provided because majority of those riding in the terminal or along the first (and second) segment have the last (or last two) segment as their destination. This may also be true for the other bus routes chosen.

6. CONCLUSION AND RECOMMENDATION

The results show that it is possible to provide express bus service in Metro Manila on the following routes shown in Table 7 during the morning and afternoon peak periods based on the passenger demand along these routes.

Table 7. Proposed Types of Bus Express Service Along Current Bus Routes

Proposed Express Service	AM Peak Period	PM Peak Period
One-to-one	Lawton to Alabang	Lawton to Alabang Alabang to Lawton
One-to-many	Quiapo to Ayala Alabang to Lawton	-
Many-to-many	Pasig to Leveriza Sta. Cruz to BF Pilar BF Pilar to Sta. Cruz	Leveriza to Pasig Sta. Cruz to BF Pilar Quiapo to Ayala

The salient features common to the bus routes chosen for the express type of service are the following:

1. The middle segments of the bus routes are expressways or major arterial roads where controlled access of both vehicles and pedestrians are in place thereby providing unhampered flow of buses;
2. The bus operator is either the sole or the dominant provider of bus service and buses are somewhat dispatched at the origin terminal in a controlled way;
3. There is insignificant, if any, competition from other modes along the route being serviced; and

4. Majority of bus passengers coming from the origin terminal or the first (and second) segment has the end terminal or the last (or last two) segment as their destinations.

The government should look further into this aspect of bus operation since bus firms that are privately owned should be given incentives and support. Incentives need not necessarily be in the form of taxes or subsidies but those that support the actual operation of buses as they serve the commuting public. This may be in the form of traffic management measures giving priority to high occupancy vehicles, such as exclusive bus lanes, bus priority at intersections, provision and maintenance of bus stops and the like.

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