

Pre-Feasibility Study for Bus Rapid Transit in Dakar, Senegal

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Preliminary Bus Rapid Transit Concept **For Dakar, Senegal**

I. INTRODUCTION

This report represents the results of two preliminary studies of the feasibility for Bus Rapid Transit (BRT) in Dakar, Senegal. The report was written by Walter Hook, Executive Director of the Institute for Transportation and Development Policy (ITDP), with Aimee Gauthier, Africa Desk Officer for ITDP, based on the aforementioned studies of Xavier Godard and Cisse Kane, independent consultants to ITDP. Some input from Systra was also used.

It was financed by a grant from the US Agency for International Development. ITDP is a US-based non-profit organization of transportation experts which provides technical assistance to municipalities in developing countries.

The report is not intended to indicate that decisions about many critical issues have already been taken. This report is rather intended to give a general idea to Senegalese decision makers about the range of options that are available for BRT in Dakar and show a very rough idea of how it would perhaps best work. It also sketches out in very rough terms the costs and possible revenues to help with the next phase of planning.

Our thanks to President Wade, CETUD, Dakar Dem Dikk, the Ministry of Transport, Systra, Connex, Paul White, Col. Mbarek Diop, and Nathaniel Heller.

II. BACKGROUND

Dakar, like many cities around the world, is facing an increasingly intractable transportation crisis. In Dakar, it is estimated that a 100,000 to 300,000 hours of mobility were lost daily in 1998 because of traffic congestion. All together, some estimates of the costs that this traffic situation imposes on Senegal every year run about 2% of the GNP.

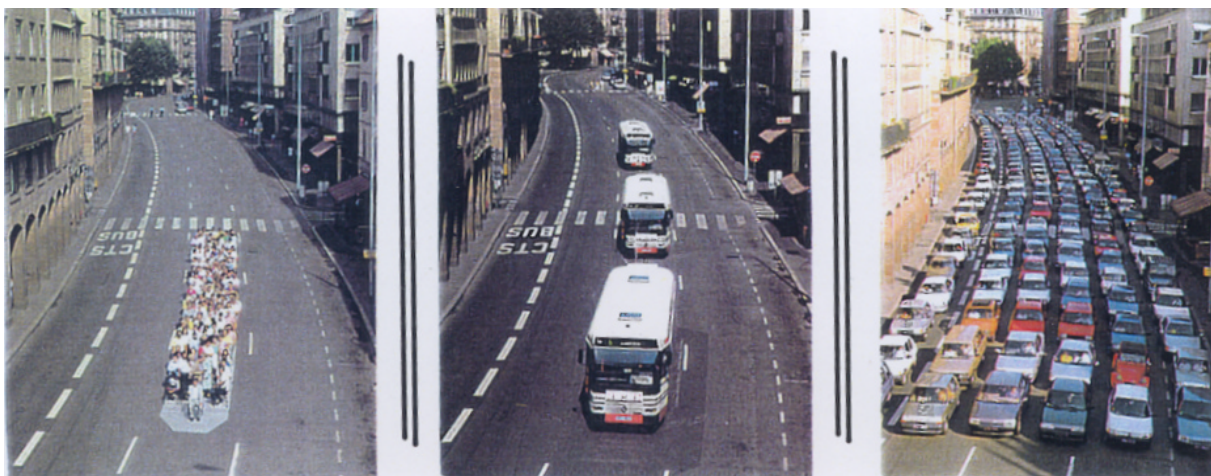
Dakar also has a worsening problem of air pollution. From 1994 to 1996, when traffic congestion was getting worse, cases of severe respiratory illness increased by more than 30,000.



Traffic congestion in Dakar

Today, the motor vehicle fleet in Dakar is growing at over 8% per year, mainly due to the mass importation of used cars from Europe. Despite this massive influx, only about 10 % of the population in Dakar owns a car. Nonetheless, this small wealthy 10% consume the vast majority of Dakar's scarce road space. Meanwhile, the 76 % of the population that uses some form of collective transport faces worse and worse traffic congestion. Bus speeds have dropped to under 10 km per hour on some routes, a speed matched by an average bicycle. The only solution is to get more people out of their private cars and onto higher quality public transportation systems.

Dakar is on a narrow peninsula, and most of the trips are heavily concentrated on reaching Plateau, the central business district. Unlike many African cities, which sprawl in all directions at rather low densities, Dakar has a similar urban form to cities like Hong Kong and Bombay, India, which have some of the highest densities in the world. Such cities, which are severely constrained in terms of available road space and where a premium must be placed on the efficient use of this scarce public resource, are ideally suited for high capacity mass transit systems. Dakar's density is not that high, but it is very high by African standards, and well suited to the middle range mass transit options that BRT offers.



The amount of space required to transport the same number of passengers.

Currently, Dakar has a bus fleet, but it moves less than 3% of the population. Most important to Dakar's public transit system are the informal minibuses, car rapides and Ndiaga Ndiayes. These vehicles carry the heaviest load of passengers. But unregulated competition between them and traffic congestion undermines the profitability of this business, making it difficult for the operators to invest in more modern, cleaner and safer vehicles. They stop in unregulated locations, sometimes consuming two full lanes of traffic. Furthermore, the competition for passengers along the roadway means that they run down pedestrians. Transit drivers caught in congestion end up having to work much longer hours without a commensurate gain in profitability. Thus, they do not have the money to invest in bus procurement and maintenance.

Current paratransit buses and minibuses are dangerous and uncomfortable. Often tires are worn until they blow, usually while in traffic. These vehicles also tend to be older and pollute heavily. In Dakar, the conductors stand outside on the back of the bus right above the tailpipe emitting black clouds of exhaust, breathing emissions all day long. Finally, the service is quite expensive for most people. While a trip is only CFA100 (about \$0.20), most people have to take two or three trips to get to their destination. As a result, car rapide fares for longer trips in Dakar are higher than they are on the Bogotá or Quito Bus Rapid Transit system, where bus fares are \$0.30 in Quito and \$0.40 in Bogotá. These revenues entirely cover the cost of modern buses and all the operations, while in Dakar these funds cannot cover the costs of vehicles generally over 10 years old.



Dakar's car rapides with the conductor standing on the back

Solving Dakar's growing transportation problem is a central concern of the government, hence the agreement by the Government of Senegal to borrow \$70 million from the World Bank, \$17.3 million from the Agence Francaise de Development, and \$7.6 million from the Nordic Development Fund for an Urban Mobility Improvement Project (PAMU).

This project included funds for modernizing the fleet of car rapides, for road and intersection construction, for bus stops and stations, and for considerable transportation planning efforts. Currently, the loan has reached its midterm point, but to date, problems with implementation have led to only 3.8% of the funds being spent. Bus priority was included as one of the list of measures suggested in the PAMU, but ultimately no actual funds were allocated for this purpose.

Meanwhile, Dakar, like more and more cities around the world, is exploring whether bus rapid transit (BRT) may offer a solution to these manifold problems. BRT is essentially a metro system that operates on surface streets using bus technology. It offers the benefits of a metro system, but with much greater flexibility and at a fraction of the cost – a cost within the means of low and moderate income countries. If a country can afford to spend \$10 million dollars (USD) on a single highway interchange that will have only a modest impact on congestion, then \$20 - \$40 million to actually solve the problem is a reasonable price to pay.

BRT began in Curitiba, Brazil in the 1970's. From there, BRT spread to other Latin American cities, including Sao Paulo and Porto Alegre in Brazil, Bogotá, Colombia, and Quito, Ecuador. In the past decade, BRT systems have been constructed or are being planned in China, Indonesia, India, France, England, Australia, the Netherlands, and now even the United States. In Sub-Saharan Africa, four BRT

systems are being actively developed, if Dakar is included: Cape Town, Dar es Salaam, Accra, and Dakar. Of these cities, in our opinion, Dakar's geography, road system, and transit network is the best suited of the four for BRT.

Dakar began to explore BRT after some preliminary presentations by ITDP to the Conseil Executif des Transports Urbains de Dakar (CETUD) and other local decision makers, and to President Wade in 2002. In January of 2003, ITDP sent Enrique Peñalosa, the former Mayor of Bogotá, and other experts to Dakar to hold workshops as part of the "Building a New City" tour. President Abdoulaye Wade and several top officials expressed great interest in replicating many of Bogotá's experiences.

Immediately afterwards, ITDP sent three experts from Dakar to the International Seminar on Human Mobility in Bogotá in February – two from CETUD and one from the municipality. CETUD is the implementing agency for PAMU, and due to the importance of coordinating the busway plans with the World Bank project, CETUD was identified by the Ministry of Transport as the lead agency for developing any busway plans.

In May, ITDP coordinated a visit by Mr. Malick Ndiaye, senior advisor to the Minister of Transport, to Paris and to the famous busway in Rouen, France. ITDP arranged for CONNEX, the transit authority in Rouen, and the consulting firm SYSTRA to give a technical workshop and tour of the system. As a result of a favorable report, the Minister of Transport, Mamadou Seck, indicated an interest in exploring the possibilities for developing a BRT system in the 2006 – 2008 time frame.

In September, a French and American technical team consisting of Dr. Xavier Godard and Dr. Walter Hook began developing the preliminary BRT plan reflected in this report. This was followed up with a visit by Cisse Kane and other staff.

Currently, Malick Ndiaye, advisor of the Minister of Transport and Equipment, indicates that the Minister of Transport has not yet given his opinion on whether or not to proceed with a BRT project in Dakar and has asked to be given additional details as to what such a system might look like. There is also considerable interest by the Mayor of Dakar and the Mayors of Guediawaye and Pikine in some sort of affordable public transit improvement, and BRT, trams, and upgrading of the Petit Tren Blu (PTB) have all been discussed.

The Global Environmental Facility's (GEF) Standing Technical Advisory Committee in 2001 decided to prioritise BRT projects and was particularly interested in pilot projects in Africa, a region heretofore neglected. As such, ITDP took the strategic opportunity to propose to the GEF steering committee to explore Dakar as a possible location. The planning preparation grant of \$25,000 has been approved. This could yield up to \$1 million for a BRT project in Dakar. However, this source of funding requires matching funds, which to date have not been secured from the government or other sources.

This report is ITDP's effort to give as many concrete details as is currently possible about what a BRT system in Dakar might look like, given limited information. It is hoped that it will answer enough questions and generate sufficient enthusiasm to secure from various international sources (whether the GEF, the Government of Senegal, CETUD, the World Bank, or US AID) the funds necessary for proper planning and implementation.

III. DESCRIPTION OF BUS RAPID TRANSIT

Bus rapid transit, although flexible enough to appear in many forms, is best understood as a **surface metro system**. While incorporating the features of a metro system such as rapid boarding and dedicated right of way, it is 20 to 100 times less expensive than a metro system.

Bus rapid transit (BRT) systems vary widely and are customized for each urban area, but their primary characteristics include:

- segregated bus lanes,
- rapid boarding and alighting,
- clean, secure and comfortable stations,
- efficient pre-board fare collection,
- reformed licensing and regulatory regimes for bus operators,
- transit prioritization at intersections,
- integration with other forms of public transport,
- clean bus technologies,
- Attention to consumers' needs, and
- A clear and attracting marketing identity.

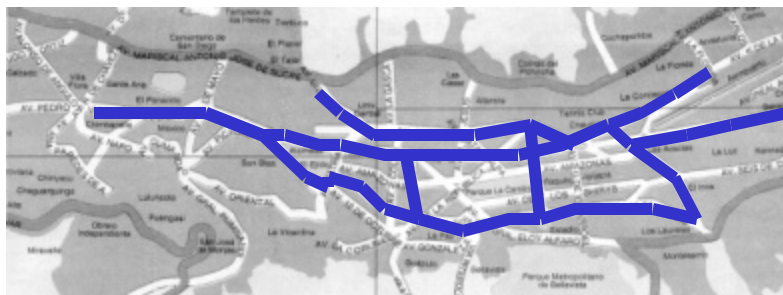
The cost difference extends to other infrastructure items as well – a BRT station can cost \$30,000, while a light rail station could cost \$40 million. The construction times are also less, thus lessening the impact on other road users, making it more popular among the public and thus more politically feasible. Bogota's system was built from initially planning to opening in only two years. It cannot be done quickly *and* cheaply, however.

Like a metro system, BRT systems seek to emulate the efficiency achieved through good design. Good design and attention to detail is the difference between Bus Rapid Transit and typical bus systems. Techniques to speed up boarding and alighting times include loading ramps such as those used in Curitiba and Quito, pre-paid fare collection, wider doorways, and an increased number of doorways. The method of fare collection has a significant impact on passenger flow times and the system's overall impression to the customer. Most importantly, having fares paid in the station before entering the bus reduces the long delays that accompany on-board payment. Some systems,

Rail



Bus Rapid Transit



Two different systems in Quito for the same cost.

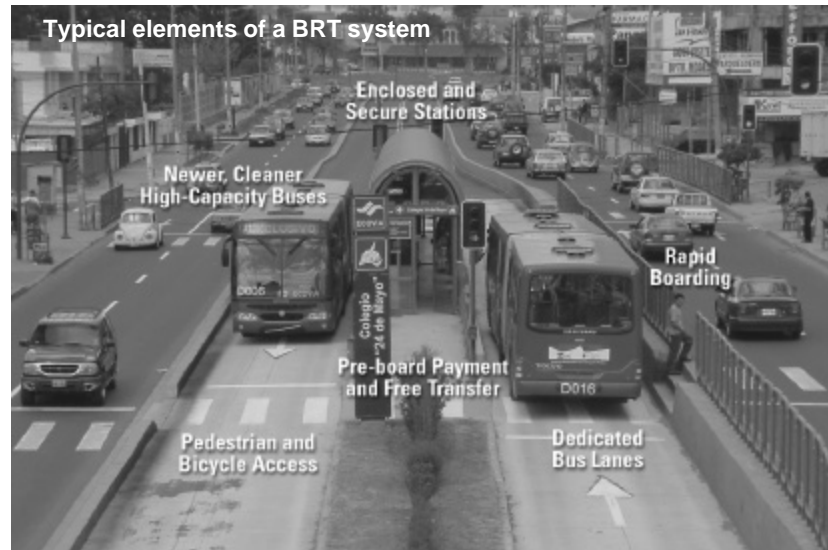
Benefits of BRT

- Flexible
- Significantly cheaper than rail systems
- Fewer traffic disruptions and less time to construct than rail
- High quality public transit
- Good design
- Efficient passenger boarding
- Relieves congestion
- Multimodal
- Route optimization
- Schedules and itineraries
- User friendly

such as Quito, Ecuador, employ fare machines that avoid the need for tickets. Some cities, such as Washington, DC, are utilizing Smart Card technology to increase customer convenience. Thus, buses can be designed with multiple large doors, just like a metro car. Because hundreds of passengers can get on and off all at once, the delay is much less than for a normal bus, and comparable to metro systems.

Stations are an important element to BRT systems. Station design has a significant impact on safety, security, and customer satisfaction. Information provided through signage, maps and real-time information displays, as well people who work as information providers, determine how user-friendly the system is to the public. Visual appearance is also key. By being user friendly, safe, and visually arresting, people feel better about using the system, as well as navigate it better, too.

Moreover, bus rapid transit stations help catalyze new economic and employment opportunities by acting as nodes of development.



BRT systems should be designed based on the number of passengers they will need to carry. Some corridors in Asia and Latin America move over 50,000 passengers per direction per hour. To date, the upper limit that a BRT system can handle is about 50,000 passengers per direction per hour. For a metro system, 80,000 passengers per direction per hour is the upper limit. In Africa today, there are probably no corridors with anything close to 50,000 passengers per direction per hour.

There are numerous ways of adjusting the BRT system's design to accommodate the level of demand that exists in the corridor. Larger buses, wider doors, bigger stations, a passing lane at the station stop, two full lanes, creating express lines and local lines – all help to define the system's capacity and operating speeds and can be adjusted to meet the demands of the customers.

By paying bus operating companies by the kilometer and tightly regulating where the buses stop, the chaotic behavior at the curb lane is removed, freeing up road space for mixed traffic. Since some buses have platform level boarding doors (with no steps down), it is impossible to discharge or board passengers except at the station. Thus, this can help alleviate the problem of frequent and sudden stops that result in more congestion and potential accidents, as well as picking up and leaving passengers in unsafe areas (such as the middle of the street). Private bus operators are generally contracted to operate the system, and their profits are fairly secure because they are paid by the kilometer

Comparison of BRT Systems, Capital Costs, and Capacity

Line	Capital Cost/Km (\$ million)	Actual capacity (passengers / hour / direction)
Hong Kong Metro	\$220	81,000
Bangkok Skytrain	\$74	25,000 – 50,000
Caracas Metro	\$90	21,600-32,000
Mexico City Metro	\$41	19,500 - 39,300
Kuala Lumpur LRT Putra	\$50	10,000 – 30,000
Bogotá TransMilenio	\$5	35,000 - 45,000
Sao Paulo Busways	\$2	27,000 -35,000
Porto Alegre Busway	\$2	28,000
Curitiba Busway	\$2	15,000
Quito Busway	\$2	9,000-15,000
TransJakarta	\$1	8,000

The most famous BRT systems in the world are in Curitiba, Brazil, Quito, Ecuador, and Bogotá, Colombia. Curitiba was the first, and is still an excellent system. Bogotá's TransMilenio has the highest capacity (about 50,000 passengers per direction per hour), the highest commercial speeds (around 25kph), and the highest quality pedestrian services and stations.

Bogotá's success was expensive, and made possible by a high level of political commitment from a very enlightened mayor. Quito's new Eco-Via, a 25-km system, is not nearly as nice as TransMilenio, but it shows how much can be done for far less. Quito's new lines are also self-financing at a fare of only US\$0.30. While Bogotá relied heavily on world class international consultants, Quito was planned and implemented entirely under the auspices of its own talented city planning agency using its standard operating budget, and the planning and construction were done at about 1/5 the cost per kilometer of the Bogotá system (about \$1 million/km with an additional \$1 million for rolling bus stock for Quito compared to about \$5 million for Bogotá). Quito's system is also routed through the very narrow streets of its historical core, proving that wide arterials are not a prerequisite for a successful system.

Quito is a good system to examine as it shares many of the same characteristics as Dakar. Both share similar geographic constraints that limit and define growth, with Quito located in a valley hemmed in by mountains and Dakar being a peninsula girded by water. Both have historic dense downtowns which affect BRT design. Quito has shown that buses can operate in the narrow streets of historic centers. Both share similar economic and socio-economic profiles. Quito's system was built in the reality of limited resources and physical constraints. Finally, Quito's system is self-financing, a successful model for any country.



Bogotá



Quito's BRT system



IV. PRELIMINARY CONCEPT FOR A DAKAR BRT SYSTEM

This section represents ITDP's first attempt to develop a preliminary concept for a BRT system in the City of Dakar.

It is developed with the assumption that BRT in Dakar should be designed in a way that it could be self financing in the medium term. While the infrastructure should be paid for and maintained by the public sector, bus operations, bus maintenance, and bus depreciation should all eventually be covered by the fare revenues. One of the primary advantages of BRT systems is that by taking buses out of the roadway congestion, their operating costs are greatly reduced, and their competitiveness with alternative modes is increased – hence their operations can be made profitable and contracted out to private operators.

Secondly, it should be designed in a way that minimizes the fiscal burden on the government regarding the up-front capital costs. This means that routes should be prioritized that do not require new land acquisition or displacement, that routes on roads already planned for reconstruction should be prioritized, and that a range of low and medium cost solutions to specific engineering problems should be suggested, and high capital cost solutions avoided when possible.

Third, the BRT system should provide a significantly superior quality of service over existing bus services, have an independent marketing image, and be able to attract passengers from higher income private motor vehicles and taxis. However, the fare of the busway should be close to the current bus fares (within 20%, for example).

With current fares at CFA 100 – CFA 175 per trip, (about \$0.20 - \$0.35) for short trips, this level is consistent with BRT fares in Quito, Bogotá, and other third world cities, and should generate sufficient revenue to maintain a reasonably high quality system.

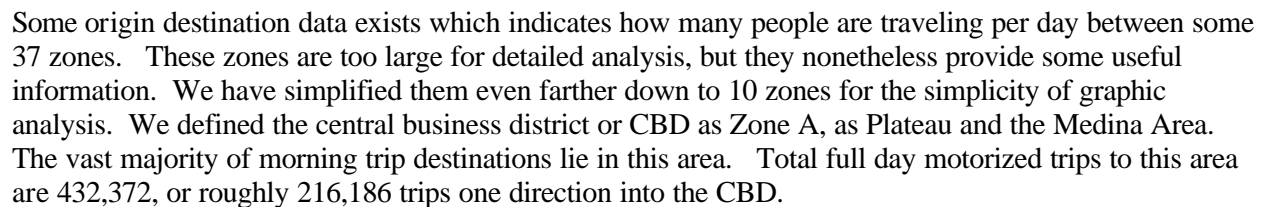
Route Selection

Many factors generally go into the selection of a specific route. They are ordered roughly in order of importance:

- The location that best serves the existing transit demand and general travel demand;
- The availability of government funds for road construction, land acquisition, and relocation;
- Locations that pass through congestion points where most time delays for transit vehicles are occurring;
- Strategic opportunities: roads already scheduled and funded for construction or reconstruction;
- Minimization of conflicts with trucks and other delivery vehicles; and
- The availability of right of way or under-utilized road capacity.

Ideally, the Dakar BRT system should be designed based on a reasonable estimate of public transit demand under different scenarios. Doing this sort of scenario testing requires a traffic model with sufficient detail to capture at least existing bus and minibuses itineraries and frequencies, and basic origin-destination survey data specifically for transit passengers, but ideally for all passengers. To date, this has not been done and will be a priority for the next phase of work. The terms of reference for the consultant to do the master transport plan for Dakar, we believe, includes conducting a new origin-destination survey to be completed in the next 16 months. However, some preliminary conclusions can be drawn from what data does exist.

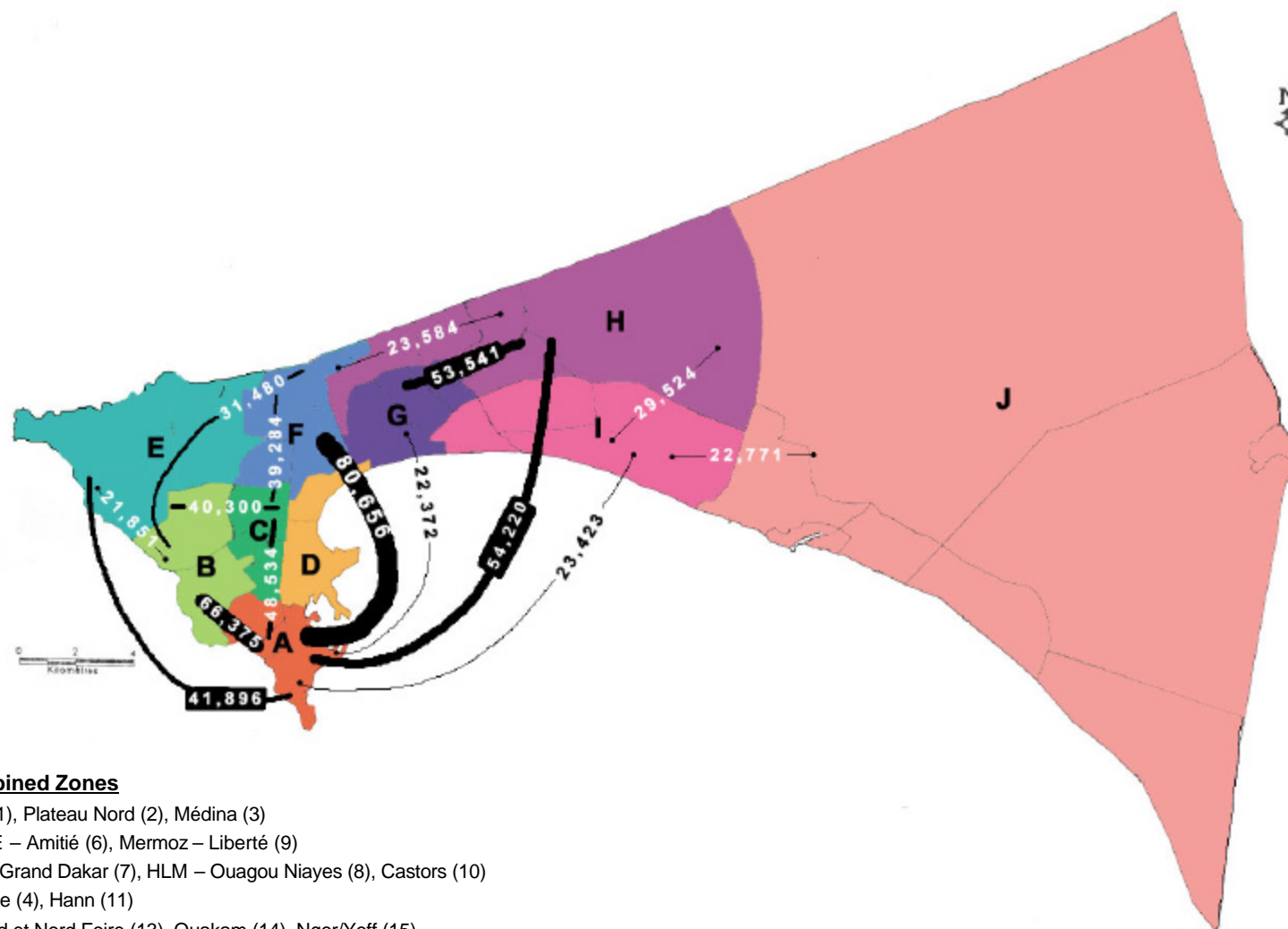
Map of Population Density¹



Dakar Busway Pre-Feasibility Study
ITDP, January 2004

Map of Origin Destination Survey

Motorized Trips – Aggregated Zones



Legend of Combined Zones

- A** Plateau Sud (1), Plateau Nord (2), Médina (3)
- B** Fann – Point E – Amitié (6), Mermoz – Liberté (9)
- C** Colobane (5), Grand Dakar (7), HLM – Ouagou Niayes (8), Castors (10)
- D** Zone Industrielle (4), Hann (11)
- E** VDN/Foire/Sud et Nord Foire (13), Quakam (14), Ngor/Yoff (15)
- F** HLM Grand Yoff (12), Patte d'Oie – Mariste (16), Parcelles Assainies (17)
- G** Dagoudane Ouest (21), Dagoudane Est (22), Dalifort – Forail (27)
- H** Guédiawaye Centre (18), Guédiawaye Ouet (19), Guédiawaye Est (20), Thiaroye/Yeumbel (23), Malika – Keur Massar (26)
- I** Diamaguene (24), Mbao/Zone Franche (25), Thiaroye/Mer – Ginaw Rail (28)
- J** Rufisque Ouest (29), Rufisque Centre (30), Rufisque Est (31), Rufisque quartiers traditionnels (32), Bargny (33), Sébikhotane (34), Sangalkam (35), Diamniadio (36), Yenn (37)

As studies indicate that peak volumes (between 7 am and 8 am) are only about 10% of the total day tally, peak hour volume for all trips into the CBD should be in the range of 21,000 per direction per peak hour. As modal split in Dakar is 76% for collective modes, if the busway were to capture ALL existing collective transit passengers, the busway would need to move some 15,960 passengers. If it attracts at most another 25% more passengers due to growth and modal shift, this would increase volumes to roughly 19,950 passengers during the peak hour.

The only non-Plateau focused concentration of traffic volumes is between Pikine and Guediawaye and surrounding areas, where approximately 50,000 one way trips could be observed. Peak hour flows would, then, be in the 5,000 range. As this is in addition to a roughly similar level of demand from Pikine and Guediawaye traveling into the center, trips in the 10,000 range per direction during peak hour should be observed in corridors connecting Pikine and Guediawaye, of which approximately 7,000 would be trips by some form of collective transport.

More detailed modal split for this traffic can be estimated from the table below:

Table : Modal share in Dakar 2000

Mode	%	mode	%
Bus sotrac	2.7%	Bicycle	0.8%
Car rapide	35.5%	Motorbike	4%
Ndiaga Ndiaye	22.3%	Private car	9.2%
Shared taxi	12.2%	Caleches, carts	0.9%
Other	3.2%	Metered taxi	9.2%
Total collective modes	75.9%	Total individual modes	24.1%
		Total	100%

Source Syscom/Cetud, Emtsu

Patronage of minibuses (car rapide and ndiaga ndiayes) currently accounts for some 58% of total trips, while regular buses account for only about 3% of total trips, despite the ban on car rapides and Ndiaga Ndiayes in many parts of Plateau.

As such, counts of car rapides and Ndiaga Ndiayes (NN) along their existing routes (see map on following page), such as they are definable, are critical to a better transit demand estimate. Estimates of how full the vehicles are should also be part of these counts. To design these counts, a map of these existing routes is necessary, which exists but needs to be improved.

Considering the counts made by BIPE/TER in December 1999, one can identify important minibus (*cars rapides* and *Ndiaga Ndiaye*) movements on following routes in Pikine and Guediawaye at peak hour:

- Exit of Pikine : 164 *cars rapides* and 94 NN minibuses.
- Poste Thiaroye: 82 *cars rapides* and 196 NN minibuses
- Crossroad B Thioune : 122 *cars rapides* and 99 NN minibuses

If these are one way counts, which needs to be verified, and the vehicles are reasonably full (an estimated 15 people in each car rapide and 30 in each Ndiaga Ndiaye), then peak hour minibus demand is roughly 6,000 per direction. It is reasonable to estimate another 1,000 bus and collective taxi passengers in this area per direction on main corridors. These estimates would need to be reconfirmed with more complete counts.

[illegible]

Another useful source of information about transit demand is DDD route and passenger information. DDD routes downtown can be seen on the map below:

Map of DDD lines in Downtown Dakar

Source: Dakar Dem Dikk



Patronage on the existing full sized buses from DDD by line indicates that the busiest routes have only around 500 passengers by line at peak hour. This is primarily due to the limited number of buses in operation. Because many lines are grouped on the same segments of routes, passenger flow is more important on these segments. These main lines are the following:

- Line 15 Rufisque-Palais: 5,116 passengers for 10 buses
- Line 9 Liberté 6-Palais: 5,258 passengers for 10 buses
- Line 23 Parcelles-Palais : 4,096 passengers for 7 buses
- Line 12 Guediawaye-Palais : 5,291 passengers for 11 buses

All this data is too limited to come to anything but very preliminary conclusions. There could also be considerable latent demand in the corridor due to the severity of existing traffic congestion. Therefore, any BRT system that is designed should be designed with a significant degree of excess capacity. Standard in the field is 25%, which is probably reasonable to low in the case of Dakar.

Roughly estimated, a single high capacity bus corridor or two lower capacity bus corridors could handle all of this demand. While this would be optimal from the point of view of efficient use of road space, it might be less optimal from the point of view of passenger convenience. Nevertheless, the OD patterns in Dakar are sufficiently concentrated that focusing public transit trips into Plateau on one high capacity corridor makes sense without too much passenger inconvenience.

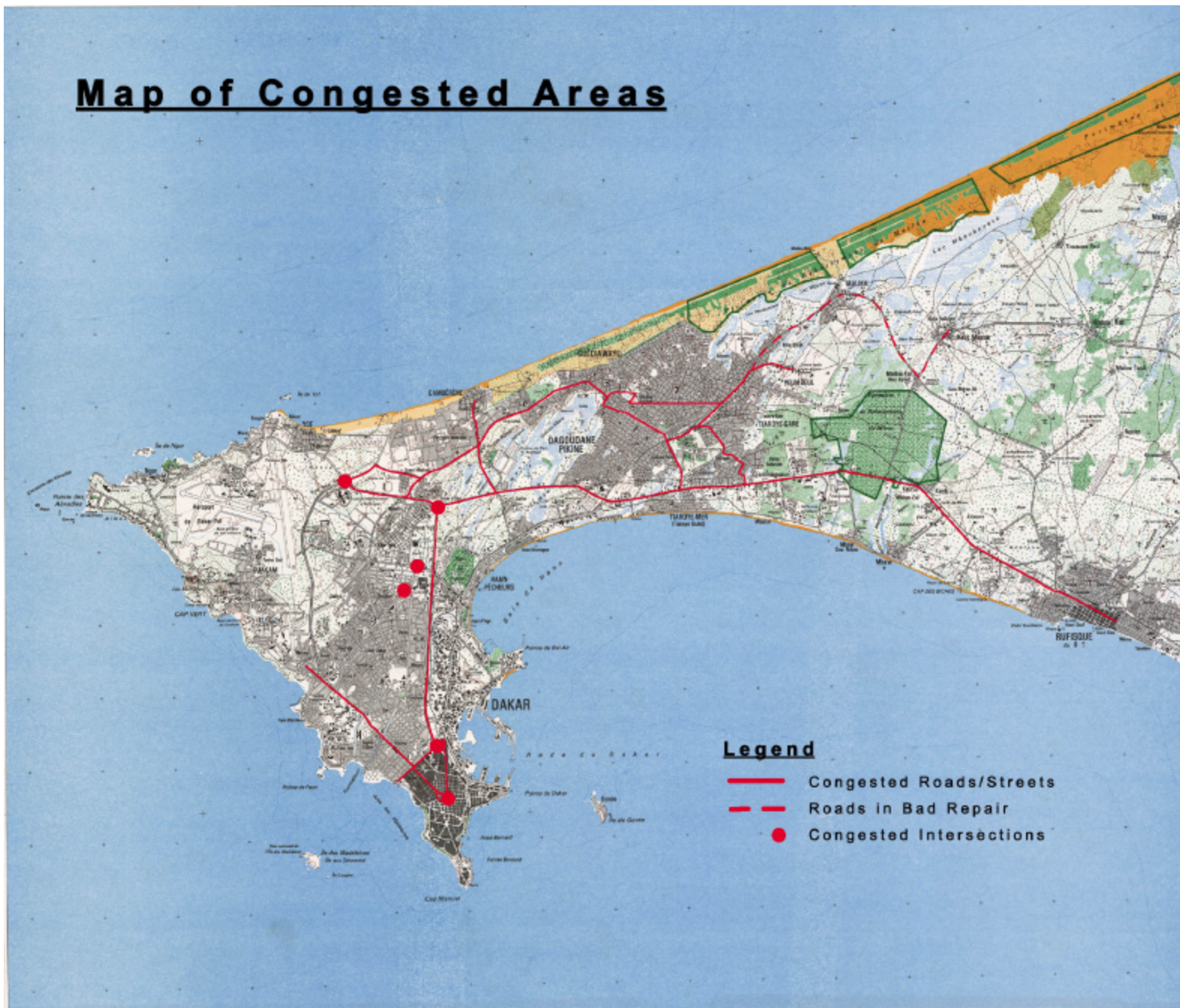
The benefit of having a single, high capacity BRT line into downtown Dakar, and a very limited network connecting to the population centers of Pikine and Guediawaye, is that it would free up the rest of the roads. All competing long distance forms of collective transport could be converted to feeder routes and pulled off the remaining streets, dramatically increasing road space for trucks, emergency vehicles, pedestrian and bicycle facilities, and indeed private motorists. Motorists and taxi drivers that will certainly complain about losing a lane of road space would be placated by the fact that congestion for them on other streets would certainly be reduced by the removal of collective forms of transport on these other routes.

Congested Areas

While some studies were done for CETUD on congestion points in Dakar, we have not had time to analyse this data in detail. However, DDD has good data about the areas of congestion that most affect their transit routes. The following list, shown on the map below, has been expressed by DDD².

² meeting with Mr Tall, director of bus operation in DDD, followed by a field visit. Eventual mistakes can come from misunderstandings.

Map of Congested Areas



- Central axes in Plateau : Ave Blaise Diagne and Ave Lamine Gueye, around Sandagal market area. The congestion comes both from street vendors and pedestrians, as well as taxi drivers who are stopping along the way.
- Ave Malik Sy, particularly access to Petersen station
- National road 1 from Rufisque to Dakar, congested despite of new improvements made some years ago in 1999-2000. Too many modes, too many activities along the road, no driver discipline, downgrading road because drainage failure during raining periods
- Ouakam Road (Ave Cheikh Anta Diop) : dense traffic
- Ave Bourguiba : it was a favourable way for buses before and now more and more shared with *cars rapides*. Congested areas particularly around the crossroad with Route du Front de terre and the crossroad with Sodida which is an industrial zone.
- Among the 4 axes though Pikine, 3 are congested and difficult for buses : Icotaf, Tali Gounas, Tali Boubess. These roads are narrow at some points and they are congested due to many street activities, especially from the central market. Tali Boubess road is impossible during raining season and it is also constrained by the parking of trucks which feed the market. Route 10 is judged better but is located at the periphery of Pikine.
- Daroukhane terminus access is difficult.
- The road from Keur Massar to Yeumbeul is not congested but the way is in a bad state. From Yeumbeul to Icotaf area, the road is very and permanently congested. One can spend two hours between Yeumbeul and Pikine. There is no space for cars rapides' about turn manoeuvres
- The highway from Camberene crossing to Patte d'Oie rotary is very congested
- The Route des Niayes capacity is limited by many activities along the street, by sand on the way and so on, but the main obstacle is the famous saturated bridge : Pont de la Patte d'Oie, which crosses the highway to the airport.
- VDN is okay on its main part but is limited by the 2x1 way bridge close to Parcelles Assainies. The difficulty comes from the fact that VDN implementation is not finished and one needs to extend it at minimum to Camberene

As these congestion points cover virtually all of the main arterials into Dakar, a large majority of bus routes are constrained by congestion. It is obvious this generalized phenomenon of congestion is threatening DDD productivity and its financial viability. The commercial speeds estimated by DDD confirm all these observations. The official commercial speeds calculated for the operation are actually more and more disturbed by the congestion and random factors on routes: the reality is worsening.

Table: The commercial speed on the main lines (km/hour)

Line	Time by travel (minutes)		Commercial speed	
	Peak	Off peak	Peak	Off peak
9 Liberté 6-Palais	95	70	8	11
12 Guediawaye-Palais	110	90	15	18
15 Rufisque-Palais	120	100	18	21
23 Parcelles-Palais	105	95	12	13

Source DDD

Thus, the main congested areas concern the access to Plateau and almost all the areas of Pikine and Guediawaye. A BRT project has to address needs in the central area in Dakar but also in Pikine and Guediawaye where travel needs are so numerous and the roads so few.

Strategic Opportunities: Roads already slated for reconstruction or widening

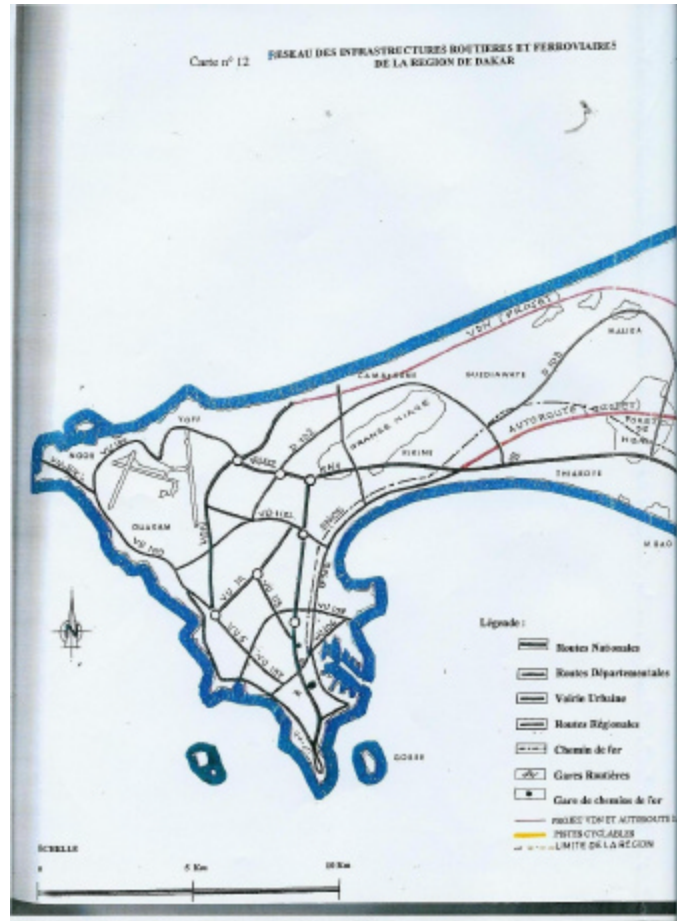
The map below shows the main road construction projects that are currently included in Senegal's plans, as well as for funding under the World Bank's PAMU, to the best of our knowledge.

These road construction projects essentially concern:

- The widening of the main freeway that will be widened from two to three lanes;
- The extension of the VDN to Diamniadio, passing through Guédiawaye;
- An exploratory study only on the possibility of the widening of the road of Rufisque; and
- The planning and extension of the freeway Dakar - Thiès to the railway station.

The realization of a station for long-haul freight carriers at Diamniadio, and the extension of the freeway to the Plateau railway station, which needs to be verified, are part of these projects. Several intersections will also be reconstructed:

- Patte d'Oie,
- Colobane,
- Cynros,
- Grand Médine,
- Malick Sy X freeway,
- Cambérène road X National Road 1,
- Pikine entry X National Road 1,
- Pikine Entry X Baux Maraîchers Station,
- Thiaroye routes des Niayes X National Road 1, and
- Diamaguène - Road East LGI X National Road 1.



We are not aware at what part of the planning stage these various projects might be. As a result, to be conservative, rather than suggesting a BRT line be incorporated into these already developed plans, this report will focus on avoiding these areas to the extent possible.

With a proper traffic model, it would be possible to determine whether a proposed BRT plan would make some of this new road construction unnecessary. Whether any of these intersections should consider incorporating BRT into their designs can be determined only after the route(s) have been selected.

Minimization of conflicts with trucks and other delivery vehicles, and the availability of right of way

The shortest distance between the rapidly developing areas of Pikine, Guediawaye, and points to the East would pass along the Boulevard du Centenaire de La Commune to Ave. d'Arsenal. This route, however, is central to freight movement and hence the vitality of Senegal's industrial base. As such, this route should be decongested of passenger traffic as much as possible in order to maximize the efficiency of truck travel – the economic importance of which is greater than that of passenger travel. BRT systems are difficult to integrate with truck travel. There is a strong incentive to move people from single occupancy vehicles into collective forms of transport to maximize the efficiency of the road system. However, it is also important for the purpose of clearing the road system for possibly more important truck transportation. It would probably be a mistake to take scarce road space away from trucks, increasing their travel times and costs, and hand it to bus passengers. For this reason, this route was rejected for a possible BRT corridor.

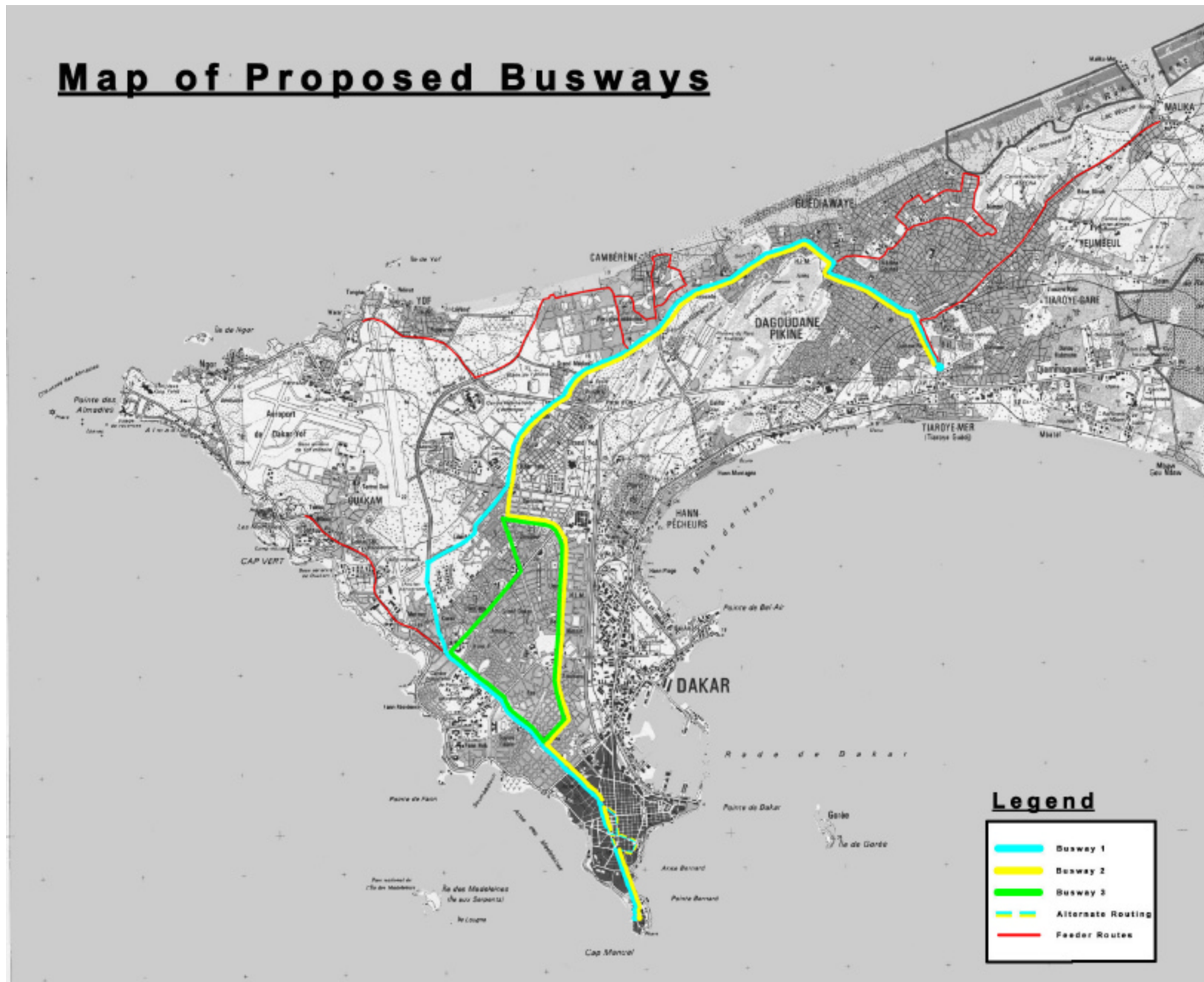
In general terms, Dakar has reserved rights of way in many locations for which many cities would be jealous. While existing roads are quite modest in width, planners of larger roads have frequently set aside large rights of way that should make it possible in numerous locations to build the BRT system in a way that adds additional road capacity rather than requiring transferring road capacity from mixed traffic to buses.

Plateau has some areas, which are quite constrained in terms of available right of way. This will necessitate breaking the BRT system into two separate one-way sections. There may also be sections in Guediawaye where available right of way may be constrained. None of these problems are serious, however, and certainly far less serious than the space constraints faced by Quito when they designed their BRT system. Nevertheless, the availability of right of way was taken into careful consideration when suggesting routings in the following section.

Preliminary Route Selection for BRT Corridors

On the map below is a very preliminary suggestion for a routing of the Dakar BRT system. It is intended as a mechanism to provoke discussion among decision makers, and has not been fully explored by ITDP. Nevertheless, we felt it was useful for the purpose of focusing the discussion.

Map of Proposed Busways





The routing suggested above is based on several considerations. First, while there is not heavy demand at the Palais de Justice, nevertheless, it is best if the bus line could connect to the existing DDD bus depot there. The lines would operate on some one way streets in downtown, using Ave. Blaise Diagne and Ave. Lamine Gueye, following current DDD routes. Included in this section are photos of the roads for proposed Busline 1. They illustrate the generous right of ways that exist along this potential line.

In summary, the proposed bus lines would follow the below routes:

Busline 1: Palais de Justice, Avenue Blaise Diagne, Avenue Cheikh Anta Diop, Route de l'ancienne piste prolongée, Liberté 6, Khar Yalla Crossroads, Grand Medine Bridge, Routes des Niayes, Guinaw Rail;

Busline 2: Palais de Justice, Avenue Blaise Diagne, Rue Lamine Barry, Boulevard de Général de Gaulle, Ave Cheikh Ahmadou Bamba, Rue El Hadj Mansour Sy, Khar Yalla Crossroads, Grand Medine Bridge, Routes des Niayes, Guinaw Rail.

Busline 3: Avenue Blaise Diagne, Ave Cheikh Anta Diop, Boulevard Bourguiba, Allées Cheikh Sidaty, Ave Cheikh Ahmadou Bamba, Boulevard de Général de Gaulle, Rue Lamine Barry



As the highest demand is from Guediawaye/ Pikine, Camberene to Plateau, we have structured the lines based on this. We are

envisioning two routes to the downtown. Busline 1 (the blue line on the map) would pass on the western side and is recommended as the first line to be built. It would run along Ave. Blaise Diagne to Ave Cheikh Anta Diop and its total length would be about 23 km. We do not know if Ave. Cheikh Anta Diop has sufficient right of way to expand the roadway but our recommendation would be to widen the road to accommodate the bus lanes rather than to convert the existing narrow road. From there the busway would continue to Route des Anciennes Pistes. From this point, the road has plenty of right of way and can easily accommodate BRT. Until the line reaches Pikine and

There is an enormous swath of empty land that parallels this road to its side.



Guediawaye, the proposed corridor has plenty of right of way. With the exception of a few short sections where the roads have already been widened, its construction would add additional road capacity in most places within this right of way rather than converting existing roads into exclusive bus lanes.



Coming through Pikine, the road is narrower, but there is still enough right of way on either side of the road to accommodate a BRT lane, although a one way loop might need to be developed here given the density of the neighborhoods. As it goes further into those neighbourhoods, it becomes more problematic, and may require some additional land acquisition, or more difficult political decisions about motor vehicle restrictions.





The second line, the yellow line, again begins in Guediawaye and ends at the Palais de Justice. However, it swings to the eastern side of central Dakar to capture attractions on that side of town, as well as the population that lives in those neighbourhoods.

Finally, a third line – a loop – is proposed for the Grand Dakar area to capture the significant travel between these zones. This provides an east-west axis through a heavily populated and active area, which, according to the OD survey done for the EMTSU study, has approximately 150,000 trips per day between zones A, B, and C.



These lanes would for the most part be the infrastructure for other lines. One of the big advantages of bus-based technology is their flexibility. Multiple lines can run along the same busway infrastructure, diverge, and then rejoin. Buses can also be made to run both on and off a busway as the system is being expanded, though this requires special buses.

V. PRELIMINARY DESIGN CONSIDERATIONS

Busway Capacity

There are two different measures of demand that need to be estimated when designing a busway. First, there is the maximum volume of transit passengers per direction per peak hour, sometimes called the 'static demand.' This is the total number of passengers that are likely to be on the buses in the busway at any given time. This 'static' demand is important for designing the busway infrastructure and selecting appropriate buses. Then there is 'dynamic' demand, which is the total number of passengers that will use the busway corridor. This is also important for designing stations, but is critically important to estimating the financial feasibility of the system. If a lot of passengers are getting on and off the buses after making very short trips, it is possible that dynamic capacity could be much higher than the static capacity.

Comparison of Bus Types and Capacity

Vehicle and operation	Av PoB	Tot -al	Stop/ Pass	capacity	
	pas	seg	seg	pas/h	veh/h
Van	15	10	3	1,137	76
Microbus	35	11	3	1,575	45
Bus	70	12	3	1,867	27
Articulated bus (w/conductor)	160	13	1.5	3,777	24
Biarticulated bus (w/conductor)	240	14	1.5	4,019	17
Articulated- High platform	160	13	1	5,120	32
Biarticulated high platform	240	14	1	5,574	23
Articulated high plat. Pay off-bus	160	13	0.33	9,779	61
Biarticulated high-plat. Pay off-bus	240	14	0.3	12,169	51

Given a total peak hour volume into Dakar's CBD in the range of 21,000 per direction per peak hour, with 76% on collective modes that could be transferred to the busway, if a single line of the busway were able to capture ALL existing collective transit passengers, the busway would need to move some 15,960 passengers. It is unlikely, however, that all transit passengers will be equally well served by the busway, inconveniencing many people if additional bus services were not provided on other routes.

Nonetheless, the system should be designed to capture at least half or more of all public transit trips in the corridor, or about 8,000. If it attracts at most another 25% passengers due to growth and modal shift, this increases volume to roughly 10,000 passengers during the peak hour. This is 'dynamic' demand, so static demand will be lower, approximately 8,000 or so. (These are very rough estimates.)

Based on this, designing the system to handle 10,000 – 12,000 passengers per direction per hour of static demand is reasonable. To reach this capacity, a fairly high quality, closed BRT will need to be designed.

Normally, a center-lane single lane (per direction) busway with closed pre-paid boarding stations using standard buses (85 – 100 capacity) could handle up to 8,000 passengers per direction per hour at excellent (20kph) commercial speeds. To get the capacity up to 12,000 at good commercial speeds (20kph or more), articulated buses would need to be used.

To get the capacity above 12,000 and operational speeds above 20kph, a passing lane would need to be provided at stations, avoiding the danger of buses backing up while other buses load and discharge passengers. For the time being, this is not necessary from a demand point of view, but might be desirable to increase commercial speeds.

This would be a substantial improvement over current DDD operating speeds, which currently range from as low as 8 kph to a maximum of 20kph on long-haul routes, averaging 13.25 kph. For the full 23 km system being proposed here with operational speeds of 20 kph, 35 minutes amount of time could be saved per full length trip. This would have good potential to draw commuters from private vehicles.

These demand levels are only marginally lower than the demand levels of the line in Quito, Ecuador, and in Curitiba, Brazil. Of the successful BRT systems around the world, Quito, Ecuador's compares perhaps the most closely to what would be feasible and desirable in Dakar.

The alternative is to have more exclusive bus lanes of a lower quality, lower speeds and lower capacity. These systems can reach various levels of capacity and travel speed depending on various factors.

Certainly a denser network of lower grade busways would be feasible in Dakar. It would require a less complicated system of feeder buses, and it would provide passengers with service with fewer transfers and shorter walking distances. However, it would require far more kilometers of exclusive bus lanes. This would not only be more expensive, it would also do far less to decongest the mixed traffic lanes and other arterials. By splitting the already reasonably low transit demand among several separate lines, the profitability of each individual line would also be compromised, possibly to the point where they would not be financially viable.

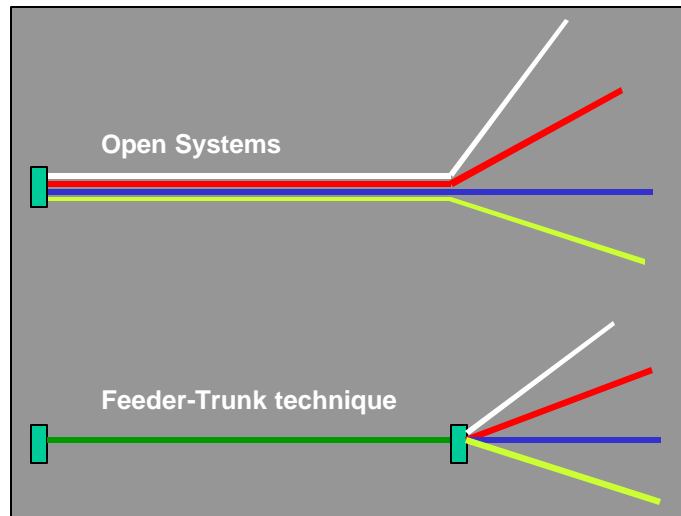
For this reason, this report recommends that Dakar develop a very limited BRT system concentrating most existing transit passengers onto a fairly limited number of high capacity corridors.

“Closed” Trunk and Feeder System or “Open” Convoy System

If Dakar agrees to a limited number of high capacity corridors, it will need to decide on whether it will develop a “closed” trunk and feeder system or an “open” convoy system.

While there are multiple ways to design a busway, there are two main ways to structure bus rapid transit systems – ‘open’, convoy systems and ‘closed’ feeder-trunk systems. The main difference between these two is that an open system usually uses regular buses operating on normal bus lines, operating inside dedicated bus lanes. Such systems still tend to operate in the center of the roadway, and have many of the other attributes of BRT systems.

Examples of successful ‘open’ systems exist in Kunming, Taipei, Porto Alegre, Honolulu, Rouen, and many other cities. These systems do not have separate enclosed stations where you pay to enter the station. They function more like standard bus platforms or tram platforms, but tend to be in the center of the road rather than at the curb.



A closed system incorporates the enclosed, pre-paid platform-level stations. This provides for much faster boarding and alighting, a cleaner, more secure, and more comfortable station and terminal, and efficient pre-board fare collection. Finally, with a closed system (trunk and feeder), there are usually a couple of main lines that operate in a closed manner. The feeder buses, while regulated, operate in normal traffic without dedicated lanes or enclosed stations. Open systems work in places with dispersed origins and destinations. Closed systems are better when there are a few main axes that concentrate the main trips.

	Closed	Open
Advantages	<ul style="list-style-type: none"> •Reduces boarding time •Reduces the total # of buses on the corridor •Makes possible very high capacity •Makes possible self-financing & privatization 	<ul style="list-style-type: none"> •Can use existing buses and route allocation •Does not require regulatory changes •Less space needed for stations •Lower cost and less transfers
Disadvantages	<ul style="list-style-type: none"> •Requires building closed stations at each stop •Requires passengers to transfer from feeder to trunk lines •Requires changing regulations and institutions •In a short system with few origins and destinations, may not be viable 	<ul style="list-style-type: none"> •Much lower capacity •Harder to control bus quality so more frequent breakdowns •Easily become congested •Lower customer satisfaction and less clear identity

The three best examples of ‘closed’ BRT systems are Curitiba, Brazil; Quito, Ecuador; and Bogotá, Colombia. These are the most famous systems in the world, with the highest quality of service, the highest capacity, the highest commercial speeds, and the most appreciated.

In the case of Dakar, we believe that the benefits of a closed system significantly outweigh the problems with such systems. The reasons for this are the following:

- Dakar, being on a peninsula and having limited roadways, is extremely constrained in terms of space. A trunk and feeder system would maximize the efficient use of scarce road space by maximizing the busway’s capacity.
- Most of its origins and destinations are concentrated along two or three fairly narrow corridors, so the problem of feeder services, transfers and long walking distances is not that acute. Feeders are also needed only at one end of the system, rather than at two ends in both Quito and Bogotá which are mountain valleys.
- Sufficient right of way exists for constructing the necessary stations.
- Control over which type of vehicles are allowed to enter the busway to avoid a breakdown that could congest the entire line is of critical importance given the lack of road worthiness testing and very aged collective transport fleet.
- Regulation of driver behavior would be maximized in a closed system, an important issue in Dakar.
- Current regulations give DDD the power to contract out the operations of such a system under its existing mandate, we believe.
- The image of a ‘high status’ system will be particularly important to attracting higher income riders and ensuring political support. Politicians are likely to get less excited about something that looks less impressive and less like a tramway. Hence, mayors and presidents will continually be attracted to higher end less viable systems like LRTs, Trams, upgrading of the PTB, etc.
- If passenger demand is split between multiple lines, given low incomes, it is likely that the revenues will be insufficient to cover the ongoing financing costs of the system.

Nevertheless, some limitations of a “closed” trunk and feeder system should be mentioned up front.

- The main reason to have a trunk and feeder system is to increase the capacity of the busway to handle large volumes of public transit trips. Right now, the volume of transit trips is not that high, and could be handled by a lower grade system. We do not currently know yet whether the demand can be increased to a level that will support a high quality system.

Nonetheless, given the limitations in available data, we suggest that a feasibility study for a “closed” trunk and feeder system be developed. In any case, most of the early planning work that needs to be done will be roughly the same whichever system is selected.

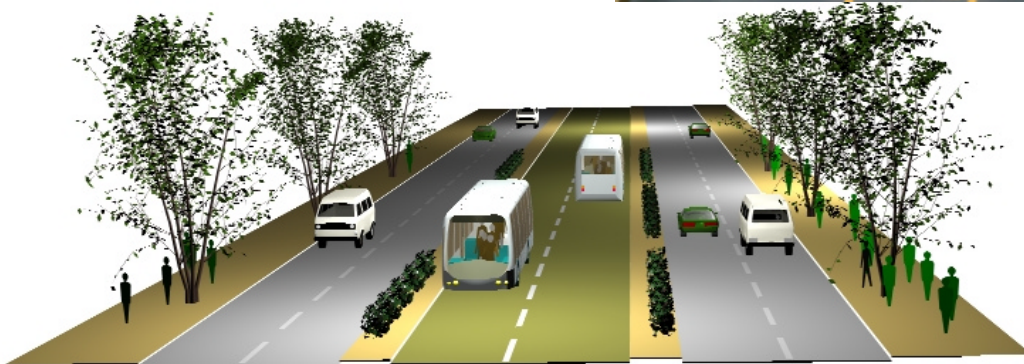
Road Geometries and Road Configurations

Many cities have standard bus lanes along the curb lane. These bus lanes are not considered a BRT system. In the curb lane, conflicts with parking vehicles, stopping taxis, pedestrians, street vendors, delivery vehicles, and turning vehicles cause so much delay to the bus system that the commercial speeds and the capacity of the system are too low to be considered BRT.

For this reason, BRT systems around the world tend to favor the use of the central lanes. However, all systems tend to use a combination of different road configurations depending on local circumstances.

Given the corridors tentatively selected, the following three road configurations could be suggested. For most of the busway that is routed down existing two way streets with many intersections and many crossing streets, the configuration below should be used:

This configuration, which is used in Quito, Curitiba, and other leading BRT systems, requires minimal space, and can still manage capacities up from 10,000 to 15,000 passengers per direction per hour, though at declining commercial speeds.





In some sections of the busway, such as our proposed Green Line along the Cerf Volant, or if a routing along the Corniche were selected, the busway could be aligned entirely on one side of the road. This configuration is desirable when paralleling a body of water, a canal, an airport, or some other area where there are no turning movements and truck deliveries across the lane.

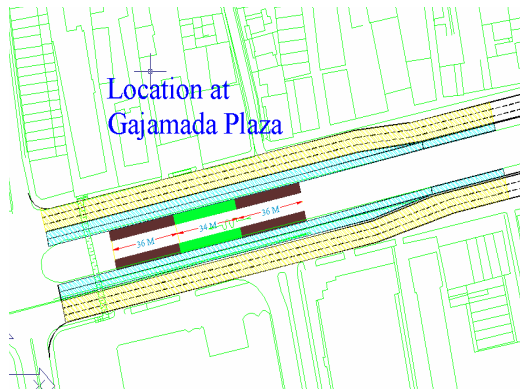


Where the busway operates on narrow two way streets, such as along Ave. Blaise Diagne between Ave. el Hadj Malike and Av. Petersen, a one way busway on a two lane road can be designed, as is shown in Quito below.



On very narrow streets in the downtown, such as along Avenue Lamine Gueye, it would be best if the road were converted into a two lane road, with a single mixed traffic lane on each side of the busway.

Another alternative would be to have only a one-lane busway and a one way mixed traffic lane along narrow downtown streets, and restrict all other commercial traffic except truck deliveries in early morning hours. To the right, this was done in downtown Quito. None of Dakar's roads are this narrow. In Dakar, this reduction to two lanes would allow for the expansion of sidewalks in the central commercial district to revitalize the downtown area.



Where possible, the operating speed and the capacity of the busway can be dramatically increased by the inclusion of a passing lane at the bus station and the splitting of stops between lines. This is probably not necessary in the case of Dakar, but nonetheless if the demand estimates come out with figures over 12,000, this design should be considered where possible. This passing lane at the station will allow for the development of express and local stops and of splitting lanes, thereby dramatically increasing the commercial speed of the busway.

The infrastructure costs of this sort of road configuration will depend on whether or not new roads would have to be built and whether the roads are built of concrete or asphalt. We would recommend asphalt with concrete at the bus stations unless concrete is locally produced cheaply in which case concrete could be considered for more of the route.

An estimate of \$1 million per kilometre would seem reasonable approximation of the cost, without any additional information.

Station Design

Dakar's BRT bus stations, should it decide to go with a 'closed' higher capacity system, should be enclosed, along the lines of those developed in Quito. The fact that the station puts the passengers on a platform at the same height as the bus floor dramatically reduces waiting times.

These raised platform pre-paid stations are the key to getting very high capacity in the busway. Multiple doors allow many passengers to board and alight all at once. These stations, from Quito, cost only around \$40,000 per station.



Bus Selection

Because the demand for the Dakar BRT is still basically unknown, it would be premature to recommend a bus technology. Bus selection should be one of the final stages of the planning process rather than an early stage decision. Certainly for the trunk lines, it can be safely said that buses with a capacity of 85 – 100 should be considered at minimum.



The bus above, which is being introduced in Jakarta in February, shows the platform height. Its single doorway, however, will limit the capacity of the busway to under 8,000 passengers per hour per direction. Even if a non-articulated bus is used, two sets of platform level doors should be considered.

In most systems with demand levels over 8,000, articulated buses should be used. In Bogotá, Quito, and most other systems, the bus with a single articulation is becoming the state of the art. This bus is pictured to the left.



The bus to the left has three sets of platform-level double doors, which allows for extremely rapid boarding and alighting, which has the biggest impact on the capacity of a busway.

Because the busway is usually a single, physically separated lane, it is critical that buses allowed to operate within it are in good working order to avoid blocking sections of the lane with broken down buses. This will require good maintenance and a reasonably modern vehicle fleet.

Bus prices are dropping rapidly as China has entered the market as a strong competitor to Brazilian, European and Turkish bus manufacturers. Most of these buses can be reconfigured to have an appropriate platform level multiple door design. Most countries, after a period of time, develop local assembly.

Full sized buses tend to cost from \$30,000 for a very cheap Chinese or Indian vehicle to \$75,000 for a diesel non-Euro II compliant bus from Brazil. For European or Japanese diesel buses prices with Euro II compliant engines will cost around \$100,000. Articulated buses will tend to cost more like \$150,000. Articulated buses can be more profitable if the demand exists, as they can carry a lot more passengers, but Dakar probably does not have the demand at this stage to justify these larger buses.

The most reasonable scenario for bus procurement is probably a single, Brazilian, Chinese or perhaps Turkish, high floor diesel bus with two sets of wide double doors but without articulation. Financial feasibility studies should be done using a \$75,000 to \$100,000 pricing estimate.

VI. VERY PRELIMINARY ESTIMATES OF FINANCIAL FEASIBILITY

While costing needs to be done specifically in Senegal, information from other BRT systems around the world can give a rough idea of the sort of costs and revenues that are generally involved.

For Dakar, if we consider a possible demand level around 100,000 passengers per day, which assumes a conservative 5,000 passengers per direction per hour at peak hour (it should be designed for far more but for economic calculations demand estimates should be conservative), and we assume \$0.35 per ticket, this yields \$35,000 in revenue per day. If that level of demand can be maintained for the equivalent of 300 days (250 working days plus 100 days at half the level of demand), annual revenues would be in the \$10 million range. This figure could be increased by raising the fare prices, which might make the attraction of private investment possible, but \$0.35 seems like a reasonable price given Senegal's per capita income.

Operating costs are typically about \$0.50 per bus kilometre or less. This figure usually includes bus maintenance but not depreciation and financing for the rolling stock, which will vary depending on the cost of the bus. If 250 buses make six 46 km round trips a day, that is 69,000 bus kilometres per day for roughly 300 full working days, that is 20,700,000 bus kilometres a year. That is roughly \$10 million in operating costs per year.

While there is enormous uncertainty about these numbers, even using conservative demand estimates, Dakar is reasonably close to being able to cover ongoing operating and maintenance costs of a BRT system. In order for a BRT system to generate additional revenues to cover the costs of depreciation of the rolling stock, Dakar will have to concentrate demand as much as possible into one or two corridors so that this corridor can maximize its ridership. Additional measures that could improve profitability would be reducing downtown parking, pedestrianization of the downtown, congestion pricing schemes, placing tolls on the highway, cutting more DDD, car rapide and NN routes, and other measures.

It also indicates that fare revenues are unlikely to cover the costs of the infrastructure or system planning. This situation is typical, as infrastructure even in the highly profitable Bogotá system was covered using government revenues.

Therefore, Dakar's system should be designed so that the full operating costs and rolling stock maintenance costs can be recovered, and with the hope that rolling stock costs would also be recoverable as demand levels grew. There should be no expectation that infrastructure or planning costs could be recovered.

Cities often make the mistake that they can spend less money on proper planning. Bogotá's success was largely the result of excellent planning, using top-notch world class consultants – the best in the business. They spent \$6 million on planning and engineering design alone. As more and more BRT knowledge is becoming broadly known, these planning costs have dropped significantly. Today, the rule of thumb is that US \$2 million is the minimum needed to do a reasonable job of the planning, but this can be less or more depending on the degree to which baseline traffic modelling has already been done.

A 23 km system as proposed for line one costing \$1 million per kilometre for the infrastructure including the stations would cost \$23 million. About 250 buses would be needed to meet a demand of 10,000 at peak hour for the full system with decent lead times. At \$100,000 per bus, that is about \$25,000,000.

Total infrastructure and rolling stock costs for the whole system then should be budgeted around \$50 million, with \$2 million for planning. If the system were built over a period of 5 years, this would be about \$10 million per year. This amount can be greatly reduced if a road is slated for construction or reconstruction anyway, as the reconstruction of a corridor for a BRT line is only some 25% more expensive than constructing it for normal mixed traffic.

The Global Environmental Facility is likely to be willing to cover half of the \$2 million planning cost of the project if matching funds to begin actual implementation can be found. US AID's support to ITDP over the remaining 3 years should be in the \$75,000 range, and some interest in increasing this contribution has been expressed. Some of the remaining planning funds could be done by slight modification of the terms of reference in ongoing studies under the PAMU.

The most logical place where such funds could be found would be the following:

1. The re-allocation of funds from the current World Bank PAMU
2. Inclusion in a Phase II World Bank PAMU loan (would delay the project beyond the time frame of the GEF.
3. Bi-Lateral grants from countries with a vested interest in the bus technology selected: SIDA (Volvo), GTZ (Daimler), Agence Francaise de Developpement, GTZ, DFID, CIDA, US AID, US TDA, the Nordic Development Fund, or other Bi-lateral agencies
4. The Export Credit Institutions of the country from where the bus supplier originates (KfW, US Ex-Im Bank, French Export Credit, Spanish Export Credit, JBIC, etc)
5. Private Investors.

VII. PLANNING THE NEXT STEPS

Current Situation

The traffic modelling capacity in Dakar in the public sector is currently quite low. A complete review of the existing data and modelling capacity can be taken from the supporting reports by Xavier Godard and Cisse Kane. Basically, no government agency in Dakar has the capacity to do general traffic modelling, let alone for public transit. Some modelling capacity may exist inside private consulting firms like Systra, but we do not know. Reasonably recent OD data has been collected, but it is for a very limited number of zones (37). This is going to greatly limit the accuracy of any demand projections for any specific BRT routing or operational structure, which in turn will undermine investor confidence in the demand projections.

DDD bus lines have been mapped and GIS maps exist, but to our knowledge the specific roadway characteristics of the road network have not been input into a functioning traffic model, at least not one where the data is under public sector control. Some preliminary mapping of NN and Car Rapide routes has been done, but it is unreliable and needs to be checked and incorporated into a traffic model.

A very limited number of traffic counts have been done, or at least the data under public control is limited. Again, it is likely that more extensive traffic counts have been done by private consultants, but we were unable to review this. Current designs of road and intersection construction projects under the PAMU have not been released to ITDP so there is no way for us to evaluate their impact on any possible BRT routing.

A recent concession contract between the Ministry of Transport and DDD gives DDD exclusive rights to operate on many of Dakar's major roads, which ensures that DDD will play a critical role in a BRT development in Dakar. From our point of view, ideally, DDD would evolve into a regulatory agency along the lines of TransMilenio in Bogotá, where they controlled the allocation of contracting to smaller private bus operators, ticketing system operators, etc. DDD has some in house GIS capacity.

Next Steps

Setting Up a Management Team

The first priority is for the government to set up a management team with clearly defined authority. Currently, this management body is CETUD. CETUD at the moment has limited in-house planning and modelling capacity. Because DDD now has the rights to operate buses on many of the main roads under a long term concession, and because DDD also has some in-house capacity in traffic planning, the government needs to decide whether the planning process needs to be centralized and capacity built at CETUD or at DDD. Our inclination right now is to base it at DDD, but under the authority of CETUD and ultimately answering to CETUD. It is imperative that at least two, and ideally four, qualified staff be assigned full time to the planning process for the project to move forward in the beginning. Later, the staff size will need to grow. A baseline minimum requirement for UNDP for the receipt of GEF funds is that this project management team be in place and its authority clearly defined.

Setting Up A Traffic Model Useful For Public Transit

A reasonably simple traffic model utilizing at least the existing OD data should at least be set up. Car rapide and NN routes should be more carefully mapped and included in the model along with the DDD itineraries. The model should be calibrated by a significant number of current traffic counts. We believe this can be done in under a year but are not yet sure. If modelling capacity already exists at a private contractor, this would obviously be a consideration. ITDP would prefer to be involved in this process, covering the costs of our own experts on busway modelling by using part of AID money, as we would like to ensure and would prefer that the relevant information and modelling capacity remain in the hands of the public sector.

Identifying Preliminary BRT Routes

The routes we have suggested above have no legitimacy among Dakar officials, DDD, or anyone else and are intended merely as a point of departure. The final route selection should involve not only the results of the modelling mentioned above but also considerations like the existing schedule for reconstruction, major drainage works being planned, and other factors beyond our capacity to evaluate.

Developing Operational and Institutional Design

Ultimately, the system's design should be based on the projected level of demand, and this in turn will be determined by the operational design. The route of the busway is only the first consideration. More important and more contentious will be the operational design. This operational design will determine how many existing DDD bus lines will need to be cut, which will be turned into feeder lines, and which should continue as is. It will also need to determine what car rapide and NN routes will need to be re-oriented to serve as feeders, which streets might need to ban car rapide and NN traffic, and which areas that do not have smaller bus service might need to develop it. This in turn will be intimately related to how DDD is reformed as an institution.

Developing Preliminary Engineering Designs

Once a basic route structure is identified and a preliminary operational design established, a demand estimate can be made. At this point, the engineering designs for the busway can be done. We understand that as-built road geometries exist for most corridors at the department of public works, probably in AutoCAD, but we have not seen them. Perhaps private consulting companies already have this information. Usually it is best to have the road engineering done by a firm with experience in road engineering, while the bus stations and pedestrian access facilities are better designed by architects and landscape architects with input from pedestrian planning experts.

Building Consensus Among Stakeholders and Public Relations

Whatever is proposed, it is certain to have an enormous impact on the everyday lives of thousands of transportation workers and owners. These individuals are likely to be extremely threatened by the changes, and involving them in the operational design is critical. The general public is also likely to not understand what is being done unless it is explained to them. Professional public relations firms can play an important role in this, in cooperation with NGOs.

Business, Financial, and Legal Evaluation

Once the engineering costs and projected revenues are known, a business plan can be developed which estimates the likely profitability of the system. These estimates will determine the degree to which private investment can be brought into the system. A contracting plan is then usually developed. The contracting should be drawn up with the input of both financial and legal experts in order to facilitate private sector financing where necessary. Ideally, the operations are contracted out to private bus operators through a process of competitive bidding, and sometimes there are layers upon layers of sub-contracting involved. APIX might be brought in for this.

Construction and Procurement Contracts

Finally, contracts for construction can be issued on a competitive bidding basis. It is typical that the construction contracts be divided into many smaller contracts, separate ones for the stations, the roads, etc. It is preferable that the construction contracts and bus procurement contracts be done in a transparent manner, and international donor agencies should insist that transparent competitive bidding be held in order to minimize project cost and ensure an optimal technical outcome. Bus procurement specifications must be done by the project team, but ideally the bus procurement itself could be done by the private busway operating company.