# Technical Report 2

# Transport Planning & Development

# PART 3: Public Transport Sector

PART 3 discusses the component of Public Transport as it sits in the context of urban transport in Dar es Salaam. It commences with a review of previous studies (Chapter 8) with a brief analysis to summarize the existing conditions and discusses the problems from the perspective of the various stakeholders particularly bus owners, operators and users.

Chapter 9 introduces a discussion on establishing the essential logical frameworks to ensure sustainability. Bus reform is a complex subject with many interdependencies that determine success and failure. A structure needs to be established, commencing with strategic policy that addresses risk, funding, incentives on the operations side as well as enabling structural efficiencies and demand responsive service designs into the transport network. Only when these factors and their mechanisms work together in a smooth and logical way will the system be sustainable.

Chapter 10 covers a review of the present BRT operational plan being developed under DART and Chapter 11 outlines the route plan developed in this master plan study covering the design logic as well as a phased introduction up to the year 2017 and outlines a 2030 plan as a long term vision.

Chapter 12 and Chapter13 develop the operational modelling to determine the viability of the route plan as well as the revenue and cost structures to determine investment scope and operational affordability.

Chapter 14 outlines a number of areas where the development of the full network impacts on the present planning of phase 1 BRT. It outlines some interchange modifications that may reduce the required investment and also promotes a more seamless by interchange for passengers using a BRT complementary bus system as proposed in the network plans.

Finally Chapter 15 discusses the short term approach to addressing the problems faced by the present daladala operators and concrete steps to begin to develop the industry for wider sector reform.

# Chapter 8 Public Transport System Review

## 8.1 Review of Previous Studies and Existing Conditions

The study reviewed three works relating to public transport in Dar es Salaam conducted since 2001, and each contributes the overall analysis of the issues facing public transport.

The work of Kanyama et al.(2004)[1] was reviewed and it provided a useful insight into user-attitudes, consumer impacts and the underlying causes of problems based on extensive survey and field work. It also raised some positive ideas for sustainable urban transportation in Dar-es-Salaam.

A Case Report on Dar es Salaam by Prof. W. Kombe & Dr.A. Kyessi et al (2003)[2] examined local transport issues across three local communities, and highlighted the issues faced by operators and users as well as providing user views on how to improve public transport.

A paper[3] by Matteo Rizzo (2001) provides a good background of the Dala Dala operations and a historical context to the present situation, and cites negative impacts of the privatisation policy as an underlying cause of much of present problems. This is relevant to the present discussion on institutional and organizational changes as privatization is often regarded as a favourable initiative to improve efficiency. Private sector involvement while being a desirable option must also under a sustainable framework and deliver desirable outcomes.

## 8.2 A Brief History of Publicly Operated Bus Services in Dar es Salaam

Dar es Salaam public transport was nationalized in 1974 the when the private bus operation of the Dar es Salaam Transport Company (DMT) a British private company which had held a monopoly for bus services since 1947, granting 'Usafiri Dar-es-Salaam' (UDA) an exclusive license to operate public buses. UDA operated under the control of the government which set fare levels according to affordability but were too low to cover operating costs. As government could not cover the financial

[1] anyama, Ahmad. Annika Carlsson-Kanyama, Anna-Lisa Lindén and John Lupala 2004 - Public transport in Dar es Salaam, Tanzania - institutional challenges and opportunities for a sustainable transportation system. (2004) Unpublished.

[2] Partnerships to Improve Access and Quality of Public Transport by Prof. W. Kombe, Dr. A. Kyessi,, Dr J.Lupala & E Mgonja (2003) – University College of Lands and Architectural Studies Tanzania

[3] Matteo Rizzo 2001 Being taken for a ride: privatisation of the Dar es Salaam transport system 1983–1998 Journal of Modern Africa Studies, 40 1(2002), pp.133-157 Cambridge university Press

gap the company went into decline. In 1975 it operated 257 buses and by 1998 it had reduced to only 12 buses. (Rizzo 2001:136)

While transport supply was in decline, demand was rising as the population had nearly tripled in the period between 1967 and 1978 and by 1988 had again almost doubled (Ibid: 137). Prior to 1974 the government had tolerated the activities of private operators alongside the public company, but in 1975 such operators were banned (Stren 1989: 52)[4] This policy was maintained until the mid 1980's when the decline of state economic capacity resulted in only 60% of transport demand being met (Mamuya [5] 1993:111).

The state countered the trend by allowing private operators to provide services under subcontract to the UDA who were given sole authority to legally register all private operators under monthly licenses (Rizzo 2001:138).

In the meantime, the bus operations of UDA went into steady decline due to:

- Deterioration in public transport infrastructure, (bus stops and terminals, the absence of bus bays, shelters, posts, benches, destination signboards and timetables.)
- Lack of funding to purchase buses and spare parts to extend the bus fleet in order to meet public travel demand;
- An aged fleet and a lack of qualified technicians, engineers and transport planners to carry out maintenance and scheduling of vehicles;
- Traffic congestion causing schedule delay and slow operating speeds;
- Poor road conditions characterised by extensive potholes that inflicted mechanical damage on the buses. As a result, UDA services became further constrained by an increasing number of unserviceable buses;
- Low fare rates that did not reflect the real market price for travelling.
- High fleet replacement costs and lack of adequate foreign exchange

*(Source: Kanyama 2004:40 Kombe & Kyessi etal. 2003:13)*

In 1991 the UDA was relieved of its role in managing subcontracts for Dala Dalas and the control was placed under the Central Transport Licensing Authority (CTLA).

## 8.3 The Rise of Dala Dalas and Their Impact on Public Transport

During the period of the late 1970's and early 1980's illegal Dala Dala services grew despite government efforts to prohibit them (Kanyama et al. 2004:40). In 1983, transport service provision

[4] Stren, R. 1989. 'The administration of urban services', in R. Stren & R. R. White, eds., African Cities in Crisis: managing rapid urban growth. Boulder, CO: Westview, 37–68. (Cited in Rizzo 2001:137)

[5] Mamuya, I. 1993. Structural Adjustment and the Reform of the Public Sector Control System in Tanzania. Hamburg: Institut fűr Afrika-Kunde. (cited in Rizzo 2001: 137)

was opened to private operators by official directive to strengthen the public transport supply and in part to comply with the Economic Reform program under pressure from the IMF (Rizzo 2001:140). This caused the government to create favourable investment policies which saw a dramatic rise in Dala Dala operations; the result being about 7,000 vehicles operating (from only 600 in 1991), according to Rizzo (2001) in a classic 'perfect competition'. Initially Dala Dalas were subcontracted under the state operator (UDA) but in 1991 was placed under the CLTA and fares were fully deregulated into a free market regime. So while the rise in Dala Dala services may have been an inevitable result of the collapse of the public bus sector it was also public policy of liberalisation and privatisation that allowed this sector to be developed.

Giving UDA sole authority to legally register all private operators was designed to stimulate investment into the private fleets, but the fare increases (with a currency devaluation of three times the fare increase) caused a combination of low affordability (to pay for bus fares) and increased costs of foreign exchange (to buy buses and spare parts) which kept operators struggling with no means to develop business from business generated capital base (Rizzo 2001:140).

When the CTLA became the only agency responsible for handling registration applications it was not given powers to reject any application except on the basis of non-compliance with roadworthiness rules. (Rizzo 2001:141) and all licenses issued were valid on all Dar-es-Salaam roads and allowing buses to operate on any route which they thought had more passengers. This introduced competition and chaos (Kanyama et al. 2004:41).

It is reported in Rizzo (2001) that over the period from 1991 to 1996, Dala Dala tariffs increased five fold, whilst the domestic currency experienced a devaluation of only about 100% and this had an effect vastly increasing the number of registered Dala Dala in operation (p140).

Furthermore, the free market was further entrenched through progressive fare deregulation when the MCT allowed operators to charge below the set fare and in 1997 a ministerial statement confirmed that bus fares would operate solely by market forces. By the end of the 1990s, the Dar es Salaam passenger transport system was almost entirely supplied by private operators under a free market regime. (Rizzo 2001:140).

In 1999 the regional commissioner took over management from CTLA to form the Dar-es-Salaam Region Transport Licensing Authority (DRTLA) to license commuter buses within the Dar-es-Salaam region (Kanyama 2001:41)

In 2004 SUMATRA was formed as multi-sectoral agency to control all air, road and marine transport and took control of Dala Dala licensing.

## 8.4 Stakeholder Perspectives

Recent research [6] involving stakeholder interviews have shown the various perspectives of the stakeholders and provides a wider and more informed perspective. Particularly it shows that the

[6] Primary data from research by Ladislaus Mkama Bigambo - Spatial Analysis of the Current and Future Public Transport Systems in the City of Dar es Salaam Tanzania – Masters Thesis 2007

problems of transport are not just experienced by users of the system, but that Dala Dala owners, operators and even regulators are equally vulnerable under the present system.

Research participants included DARCOBOA -the Dala Dala owners association, SUMATRA the regulator and SUMATRACC- the Consumer Consultative Council of SUMATRA representing the interest of consumers and drivers and conductors. Summarized briefly are the various perspectives of each group:

DARCOBOA detailed the many issues facing their members and the industry in general, particularly the lack of proper frameworks for routing and the failure of municipalities to involve themselves in the organization of transport. The only part the municipality plays is providing consent to operate, which is requisite for the insurance coverage on vehicles. Other than this they have no involvement. Dala Dala vehicles are also too old to be viable and serviceable as the industry makes insufficient return to replace vehicles at the end of their service life.

There is also little control exercised over entry to the business and bus owners can apply for a route with little qualification and very little planning is involved on the part of authorities to introduce additional buses to service.

DARCOBOA as the association of Dala Dala owners sees their members as being squeezed by a very competitive market, and although delivering an essential service to the public, feel their efforts are under appreciated. The rising cost of operation, regulated fares, free travel for police, army and prison personnel and the student fare are all contributing to the marginal financial situation as the operators subsidize consumers with no compensation from government. Furthermore the industry experienced frequent political interference without stakeholder participation or consultation. DARCOBOA also indicates that the ownership structure of Dala Dala include families that rely on this business for a main source of livelihood (widows and retired people) and therefore difficulties in business have flow-on impacts on their survival and wellbeing. DARCOBOA acknowledges that a major source of complaint is the poor service levels to customers with particular dissatisfaction over driver and conductor attitudes.

The SUMATRACC perspectives mirrored the general complaints of the users of the system, citing fare issues (too high with flat fares and transfers causing expensive journey costs) poor quality service featuring discomfort from overloading, conflict in boarding, harassment from other passengers, long waiting times etc. But the discomfort and poor service aspects were seen as secondary to the main problems of personal insult and indignity suffered at the hands of drivers and conductors.

The lack of monitoring and enforcement was a major complaint where consumers expect services to be better managed to improve services, citing unreliability, unsafe driving, cutting short trips to extract extra fares, low penalties for violations, and poor ticketing standards as rules are not enforced.

The routing problems were also mentioned, firstly that customers experience long walks to access services as Dala Dalas tend to restrict services to paved roads. Also the routing pattern often sees passengers incur an additional fare where they need to make transfers to their destination. SUMATRACC also indicated a lack of awareness by passengers of their rights and obligations.

'Ineffective political measures' was also a complaint and although not clarified it may be a general commentary on the fact that consumers see a lack of political strength in improving services where the industry is left to its own devices in providing services.

DRIVERS and CONDUCTORS were interviewed conveying their opinions on the difficulty in operating Dala Dala in a hostile and difficult environment. The driver /conductors mostly operate under a fixed daily fee regime payable to the owner and have to gain sufficient revenue to pay the owner; pay for fuel and various fees/ fines when they occur and reach a basic take-home salary. They work very long hours from early morning to late evening and often carry stress from operating in the difficult circumstances and economic hardship which also affects their families. Very few have formal employment, mostly being temporarily employed and if the bus suffers breakdown they are at risk of being unemployed. A complaint from drivers/ conductors is that they are never consulted when new rules are made or have any input to the decision-making process. As an example, the case where regulations require them to wear uniforms which are hot and uncomfortable was forced on them with no consultation. Passengers often want to argue about fares or wish to negotiate once on board and complain with little tangible cause. Driver /conductors feel they receive little respect from society and feel passengers looking down on them as they have little education. As a result of these relationships which are set in an economically disadvantaged environment the work on the bus becomes a conflict-ridden situation and the driver conductors deal with these problems on a daily basis.

POLICE – as the enforcement arm of the regulatory structure, the Police have the task of enforcing the rules and regulations set by SUMATRA as well as enforce vehicle standards of safety and compliance. This is a very difficult and unenviable task as the regulations are often in discord with on-road realities. For example if the Police followed regulation with regard to vehicle safety and standards, virtually all Dala Dala would be removed from service, as the industry cannot economically support higher standards of vehicle maintenance. This leaves the Police to find a pragmatic solution which often then involves 'turning a blind eye to obvious infringements, or on the other hand making arbitrary action as they see fit. Clearly the Police cannot address or repair the structural failures of the industry, and can only enforce the rules. Yet when failures occur (such as accidents through unsafe conditions or actions) the Police are then blames for lack of enforcement.

PUBLIC TRANSPORT USERS

The Master Plan study has conducted extensive passenger and user surveys finding that:

- The trip rate of female passengers is estimated at 0.75 trips per person per day, whereas that of males reaches 1.26 trips per person per day;
- The range of age of major Dala Dala users ranged between 10 and 49 years;
- Workers constitute major users followed by students;
- Of the population in Dar es Salaam 39% are workers, 29% are housewives and 19% are students;

- Average household income is estimated at 130,000 per month;
- Transportation cost account for between 7% and 18% of the monthly expenditure for most Dala Dala users;
- Dala Dalas carry approximately 1.4 Million passengers per day and approximately 200,000 trips are made daily by private modes.
- Transport use data showed that:
  - For all unlinked trips, walking accounted for 56% and 41% used Dala Dala;
  - Dala Dala passengers, predominantly only use Dala Dala with access and egress modes are either walking or Dala Dala. The study also found that
  - Only 56% of the Dala Dala passenger use one Dala Dala per trip and can make a trip without a transfer to their destination. The rest 44% use two or more Dala Dala per trip.
  - The average travel time per trip was estimated at 77 minutes, and waiting time mainly for transfer to another mode was estimated at 35 minutes.
  - The average travel distance ranged between 10 and 20 km under the assumption that the average travel speed of Dala Dala is 10 to 20 km/hr in peak hours (See **Table 8.4.1**)

**Table 8.4.1 Summary of Dala Dala Trip Attributes**

| Survey Location | Travel Time per Trip (min) | (Travel Time by Dala Dala) (min) | Waiting Time (min) | Fare per Trip (Tshs) |
|---|---|---|---|---|
| Mwenge | 74.8 | (54.8) | 35.4 | 314 |
| Tandika | 74.7 | (53.7) | 34.3 | 331 |
| Mbagala | 73.9 | (52.5) | 32.6 | 315 |
| Posta | 81.2 | (61.9) | 36.8 | 327 |
| Ferry | 80.4 | (58.9) | 34.1 | 316 |
| Kariokoo | 81.1 | (58.9) | 36.2 | 364 |
| Ubungo | 83.4 | (65.9) | 34.5 | 358 |
| **TOTAL** | **77.2** | **(56.7)** | **34.9** | **324** |

Source: Bus Passenger Survey in 2007, JICA Study team

The result of the household and attitudinal surveys indicated that:

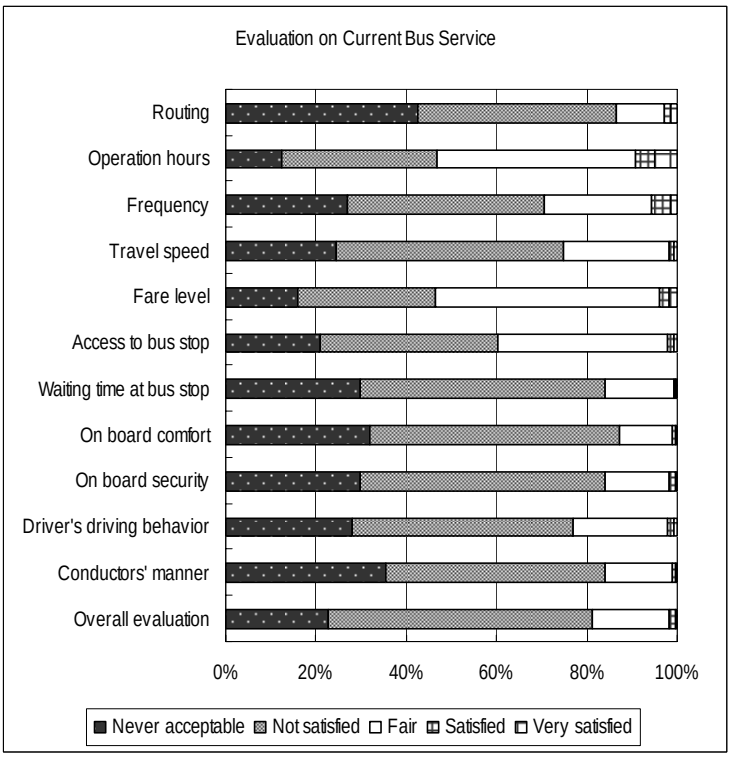
- About 98% of Dala Dala passengers have no car or driving license and are captive to Dala Dala for their travel needs, and only 0.7% indicates a preference for Dala Dala over a car.
- About 80% of passengers interviewed judge the current system as either unacceptable or at an unsatisfied level;
- Nearly 90% of passengers evaluated the routing and comfort level of Dala Dala to be

unacceptable or not satisfied at all.

- The waiting time at the bus stops, on board security and conductors manner also scored negatively.

The ranking of passenger perspectives on current service characteristics are shown in **Figure 8.4.1** showing that bus routing was the major dissatisfaction followed closely by conductor's attitude.

What is evident is firstly the high reliance on public transport and the fact that users are a captive market with little alternate choice. This is therefore a major factor in poor service delivery as undersupply means that providers do not have improve quality to win passengers. The industry can therefore survive with the lowest common denominators of quality and price.




Source: Bus Passenger Survey in 2007, JICA Study Team

**Figure 8.4.1 Evaluation of the Current Bus Service**

The survey work supports the findings of previous studies summarized by Kanyama et al. (2004) highlighting the following issues prevalent in Dala Dala service:

- Congestion and delays as passenger can wait long period before finding a bus with available space, or where buses wait to load prior to departure;
- Excessive polluting emissions from vehicles;
- Increasing road accidents due to speeding and reckless driving (and overloading), with drivers operating buses for up to 15 hours /day;
- Inadequate road infrastructure, causing vehicle damage in passenger discomfort (speeding over

poor roads);

- Poor vehicle condition causing service failures and dirty interiors soiling and tearing clothes;
- Poor infrastructure for non-motorised modes, meaning poor access to bus stops and stations, or alternatives to Dala Dala use;
- Low bus fares insufficient to cover operating costs; buses often to not complete the trip to extract more fares;
- Poor customer services – including verbal abuse by conductors, blaring horns, loud and disturbing music, bullying of school children and exploiting female students;
- Uncomfortable travelling conditions – overloading, bad smells, pick pocketing, sexual harassment and discrimination with a disproportionate effect on women, children, disabled and the elderly;
- High travel cost compared to income (10-20% of family income to transport costs);

A special category of user problems is the situation suffered by school children (an issue fully explored by Kanyama et al. 2004) as they (by government decree) can travel for a 50 shilling fare, and find themselves severely discriminated against as they are uneconomical for Dala Dala to carry. This is a major cause of concern for parents who often need to pay for 2 or more children's school travel, and causes hardship in arranging travel to and from school. The results range from high stress for students as they negotiate travel each morning and afternoon affecting academic performance to cases where sexual favours are given in return for permission to travel. The impact of this conflict on the next generation is likely to be very significant and represents an urgent community issue. The problem of school travel has recently been discussed between SUMATRA and the community with little resolution except that the solution could include the removal of the student fare, thus requiring full payment, or that the government supply special school transport services for students.

## 8.5 Findings and Conclusions on Stakeholder Perspectives

In summary, the perspectives of all shareholders are similar with little disagreement on the issues. The complaints of all participants whether provider, regulator or consumer are in fact are bound together in the nexus of the prevailing economic structures of the industry. The perspectives of stakeholders naturally focus on the symptoms of the problem; the real problem being the inherent unsustainability of the economic frameworks. Typically responses include trying to improve regulation and enforcement; arrange better organization of the industry and improve efficiency by introducing larger and more efficient buses.

However, while these responses are intuitive and carry some merit, they may not always be the solution. Firstly, increasing regulation and enforcement will prove a futile exercise if structural problems are not solved, particularly if the economic frameworks that govern the actions and behaviour of the players are not addressed. What is required is a major appraisal of the industry structure. Enacting various

remedies to address what are deep-rooted problems is completely inadequate and akin to applying a 'band-aid' to a patient to avoid major surgery.

Secondly, organizing the industry has merit as it develops a united voice, better representation and advocacy skills and a cooperative approach to service development and equity. This can be voluntary or part of an organized programme by stakeholders but without eventual structural reform this has a limited and temporary effect.

The last response has merit as a larger bus is more efficient due to the lower costs per passenger in terms of running cost (by carrying more passengers) but this is the total extent of its advantage. Unless there is orderly scheduling where the bus use is planned efficiently, the large bus will be underutilized and the increased capital cost will not be offset by extra revenue. Quiet simply, this relates to the fact that the small Dala Dala bus is inefficiently utilized while waiting for passengers. The old adage is true: "if the wheels are not turning, there is no money being made". Waiting at a terminus for sufficient passengers to load an old 'life expired' bus is more economical than waiting in a large new bus.

This point has been fully illustrated in *Chapter 15* where a full route network is developed around a BRT/secondary bus network sufficient to carry the existing passenger demand in the entire service area. The bus fleet proposed fleet comprises 170 passenger capacity buses on the BRT and 60 passenger capacity buses on secondary route networks. The total number of buses required is approximately 1230 large buses and by virtue of bus capacity alone, replaces 3,250 Dala Dala.

Considering that approximately 6,000 Dala Dala/vipanya buses operate (although some perform feeder services not covered by the proposed network) it is evident that the present system has a high inefficiency. When large buses are scheduled on service with bus allocation accurately planned to meet demand, efficient fleet utilization will result. Consequently these efficiencies will translate into lower and more affordable fares.

To move forward two approaches that can be adopted, these being:

Firstly, undertaking a comprehensive reform of the industry structure to set the industry on a sound policy and organizational footing and developing management structures that develops efficient public transport networks and sustainable operator frameworks so that quality is improved at an affordable price. The next chapter sets the foundational thinking for this type of action. It is the only real solution; the alternatives are essentially non-existent.

Secondly, an approach that is enabling for the 'on-ground' situation to cope with the wider reforms, as the industry will not just be replaced by something better - it has to become something better. In other words the industry itself needs to be reformed into the new structures through a steady process of organisational reform. This being the case, there is considerable work to be done at industry level with existing operators to prepare for changes.

***Appendix A*** sets out a short term approach for action in the Dala Dala industry but this is only as an adjunct to the major organizational reform, as without fixing the economic dilemma there is no answer.

The best short term action is speedy implementation of the long term action.

## 8.6 Present Progress on the Establishment of DART

Dar es Salaam has taken a major initiative in the establishment of the DART agency around the development of the Bus Rapid Transit system. This initiative has the full support of the Master Plan Study as it can address fundamental and structural issues of inefficiency in the bus operations. Presently the Operational Plan is complete and the DART Agency is established.

The DART Agency is a line agency responsible primarily for the BRT implementation and operation and as such will contract operators to provide services. This will initially include the BRT operation only (with feeder buses) but it is foreseen that as the system expands that all public bus transport can be placed under the DART Agency.

The Master Plan Study has raised the concept of a Dar es Salaam Transport Authority (DUTA) as an 'umbrella' coordinating authority over DART and other line agencies (such as a new Roads and Traffic Agency) and this Authority will also feature a Private Services department to oversee the licensing of privately operated bus services (that are not contracted under DART) at a local level. This represents a top and middle level action to improve transport coordination, management and regulation.

A requirement in the DART BRT plan is that BRT will fully replace Dala Dala buses along the affected corridors. This in itself involves a large displacement of a Dala Dala routes and affected operators will need to be absorbed into the new operating structures. This will happens in a number of ways: firstly the employment opportunities for drivers, security, ticketing and cleaning staff for the BRT system will take up a proportion of displaced workers, and secondly the requirement for organised feeder buses to support the BRT system (under operating contracts) will provide business opportunity for existing Dala Dala owners. Organizing operators into cooperatives or companies to take up these operating contracts under DART is essential and DARCOBOA could play a large role in this type of industry rationalization and organization and can coordinate at 'ground level' to complement what DART and DUTA will accomplish at top and middle level.

# Chapter 9 Conditions for Sustainable Public Transport

The previous chapters outlined a comprehensive picture of the existing conditions and present progress in addressing the critical issues of urban transport. However, this is insufficient to develop sound proposals for institutional reforms. In order to provide an agreed foundation for developing recommendations and proposals, this Chapter 9 seeks to outline guiding principles for the development of a sustainable and effective public transport system as integrated part of the urban transport system in Dar es Salaam.

## 9.1 Transport Balance in the Life of the City

In Dar es Salaam, there is a high dependence on public transport and also walking is a major mobility function across communities. It follows thus that, to improve significantly the life of its citizens, city development must cater in a large way for this.

A major risk to city development is the explosion in private car ownership and use generated by incomes increases, made more likely in areas / cities where public transport options are poor. A large-scale rise in car use demands heavily on public resources to cater for the necessary traffic infrastructure, a demand frequently proven to be beyond the capacity of cities to accommodate. Furthermore, increased pollution, congestion, wide traffic thoroughfares and the imposition of cars on walking and living spaces develops an undesirable living environment.

Dar es Salaam has the opportunity to avoid many pitfalls encountered by developed cities and the initiative already taken to prioritize public transport through a BRT system is a major positive step in defining a balanced city. This balance involves applying the right priorities between personal mobility (walking, NMT, cars); the essential movement of goods and freight (port and service vehicles); and an orderly planned public transport system (BRT and associated bus networks). Ultimately, the city is best served if it can create livable communities through a sustainable transport system that enhances and empowers its communities.

## 9.2 Sustainable Frameworks for Public Transport for Dar es Salaam

The previous sections demonstrated that transport management failures are mostly due to:

- Poor policy frameworks;
- Gaps in responsibility (where responsibility is vague and ill-defined);

- Responsibilities are duplicated or fragmented under a number of agencies also leading to uncertainty in resources and who provides them;
- Emphasis on regulation instead of management;
- Lack of coordination and integration across sectors and between levels of government.

Addressing these failures requires attention to four main areas of transport management and delivery including Policy, Organization and System Management which place an emphasis on 'management' and not just 'regulation', and the remaining two areas of network efficiency and operator business models which relate to service delivery.

### 9.2.1 Policy and Organization

There needs to be a clear understanding on the role and function of the various organizations in managing passenger transport. When failures occur, creating a new and additional agency because the other is not performing leads to greater fragmentation and confusion over roles and responsibilities. Particularly, there needs to be an understanding of the difference in 'regulating' and 'managing'.

Government sets strategic vision for the transport system through its transport policy and this vision needs to be translated into a strategic policy by an Authority that has the power to oversee and coordinate it. The development of a Dar es Salaam Urban Transport Authority (DUTA) is discussed in Technical Report 3.

In the context of a passenger transport network, a Strategic Policy sets guidelines for:

- Network coverage and accessibility;
- Broad service parameters (fare policy, service frequency, passenger comfort standards, safety standards);
- System specifications and system branding;
- Planning for future services including service and system expansion.

The Authority setting this policy (DUTA) will delegate its implementation to the system manager and monitor overall system performance, and by implication, the system manager's performance. It will also develop urban development policy & plans that support transport integration across all sectors.

### 9.2.2 System Management and Funding Arrangements

The system manager for public transport in Dar es Salaam is the new DART Agency. Guided by the strategic policy set by the Authority, DART will develop tactical policy to manage the business of public transport in the most effective and efficient way and take a commercial and business-like approach to maximize revenue and to minimize costs within the framework of strategic policy. The key performance measures for DART include quality indicators of service delivery as well as financial performance achieved through customer satisfaction/revenue growth and managed costs.

DART contracts the operation of the buses through a performance-based contract to bus operators who perform services according to the requirements as specified in the contract. As DART has total responsibility for the performance of the business, it monitors and enforces the conditions of the contract. Much of SUMATRAA's previous regulatory role over service delivery is thus taken over by DART.

In summary, the function of DART includes:

- Development and management of bus operation performance-based contracts (PBC) and being 'Party A' with 'Party B' bus operators;
- Specifying service levels and standards in each contract along with terms and conditions of contract;
- Planning and route network development;
- Managing fare policy within guidelines set by the Authority;
- Management and maintenance of system infrastructure and information systems;
- Monitoring system performance and contractor performance:
- Survey data and user feedback;
- Benchmarking system cost recovery;
- Safety standards;
- Enforcement of standards;
- Revenue control and financial management.

The present DART charter[1] is fully in accordance with this concept of system management.

**System funding and fare levels**

How funding is arranged is a fundamental issue and 'how the money flows' creates the incentives or disincentives for the system to succeed or fail.

Presently operators are paid through collecting single fares for single trips on single routes. This result in both inadequate financial support for the system as a whole, creating financial hardships for operators (discouraging investment) and also create significant network inefficiencies. This results in a system where bus operators are working for their own survival, often against the system. **Figure 9.2.1** shows how the present (illogical) funding structure operates.

[1] As outlined in The Executive Agencies (The Dar Es Salaam Rapid Transit Agency) (Establishment) Order, 2007.

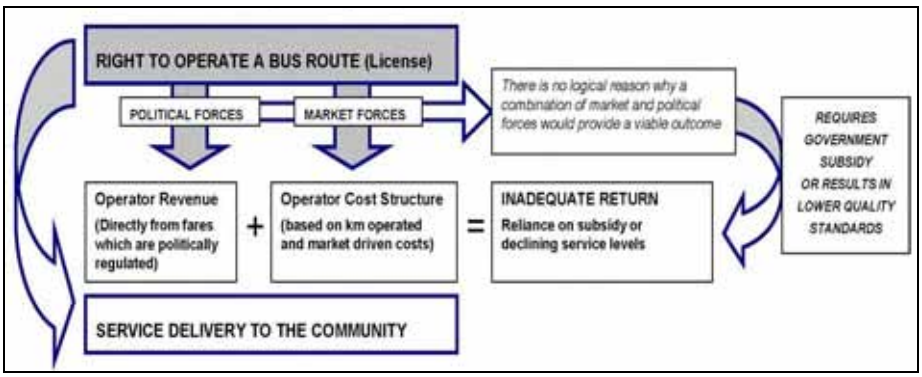



**Figure 9.2.1 Present Funding Structure (Not Logical)**

The present arrangements show a haphazard and coincidental method of funding bus operations with fare levels set through regulation or competition and having no connection to the real cost of providing services.

Funding needs to be rearranged so that revenues accrue to the network and not to the operator (separating the operator costs from network revenue). This will improve integration, allowing fares to be 'network based', and have the operator paid to deliver services to the network. Under such a regime, the system manager would collect revenue (through an integrated ticketing system) and pay operators for services provided to the network. This proposed system funding model is shown as **Figure 9.2.2** showing how government takes responsibility for the funding decisions (i.e. level of fares & service vs. subsidy level.).

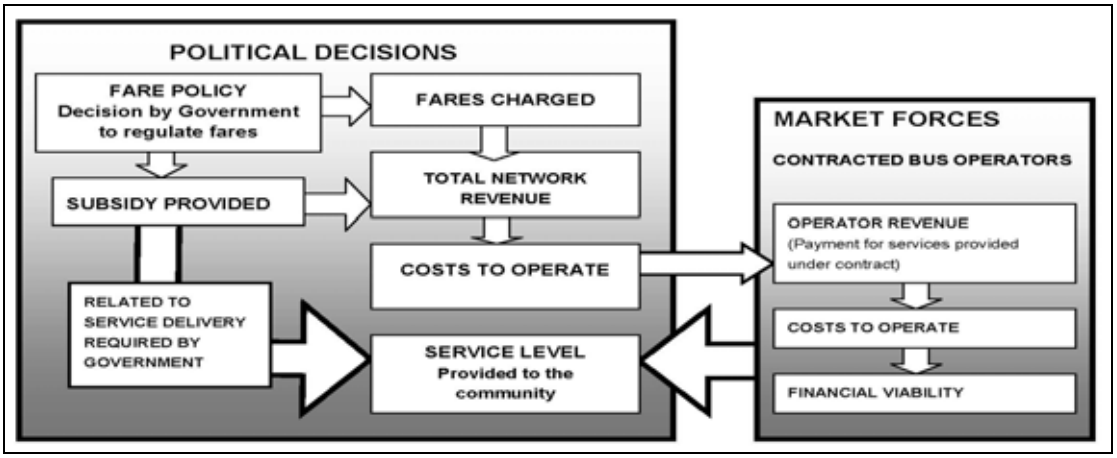



**Figure 9.2.2 Separating System Revenue and Operator Revenue**

Such a funding model will:

- Increase overall revenues to meet the full cost of operation to proper quality levels as well as creating conditions for long term investment;
- Build a system network through fare integration and common ticketing so that passengers are not penalized for transfers to other services;

- Pay operators for service delivery to the network rather than competing on a route by route basis;
- Allows for cross subsidy between lucrative and loss making routes;
- Give options to deliver subsidies more carefully to selected users, but available to all such groups across the system.

**Subsidy funding**

The logical model shows the possibility for a 'user' subsidy where the government funds the difference between a commercial cost of operation and a 'non-commercial fare level. This is not to be confused with an operator subsidy where loss-making operations are subsidized.

Avoiding subsidies is a good objective, but to succeed, requires careful strategy based on realistic principles:

- The bus operator must operate under a financially viable and profitable business model. An efficient quality service does not occur through starving the operator;
- More efficiency means less subsidy, and the government must take an active role in network development to create system efficiencies ) a BRT system is a good example);
- Creating ridership is a key objective for responsible system planners;
- Government investment into bus infrastructure to improve efficiency and service quality will reduce subsidy (increasing average bus operating speeds);
- Furthermore, reduce travel time boosts ridership leading to a 'lower cost/ higher revenue' path to efficiency and subsidy elimination.

The system manager takes a commercial and business-like approach to developing sufficient system revenues to cover the cost of operation (being the contract km costs, management and administration costs and marketing costs) and to do this within the overall constraint of providing affordable fares.

If the government wishes to maintain fare levels at 'social' level below the commercial level, then the government would allocate a subsidy to make up the revenue shortfall. The incentive is then for the system manager to build revenue and reduce dependence on subsidy – this being a key performance indicator for the system manager's performance. Should revenue fall or costs rise, the system manager has the choice of reducing services, increasing fares or use other market driven alternatives such as promotional fares, or improving operating efficiencies. These decisions can be considered along the lines of commercial business practice and government priorities.

### 9.2.3 Network Planning and Efficiency

Dar es Salaam is well progressed to developing a 'state of the art' BRT system but it is necessary to place this into a proper and objective planning context. BRT is not a 'cure-all' and its success is dependent on where it sits in the overall public transport of Dar es Salaam and whether it meets the

essential criterion necessary for success. All successful public transport systems need to include the following:

- Demand oriented services;
- Bus priority (including BRT where appropriate) giving :
  - Increased bus speeds;
  - Reduced travel time;
  - Access and integration;
- Efficient Network design.

**Demand-oriented services**

Under traditional public ownership, buses were mostly 'supply oriented' – building the system on technical or regulatory premises on the assumption that patronage will follow. More recently, transport planners have understood that consumers have greater choice, so for public transport to survive demands a 'demand responsive' approach.

For the transit user, the transit experience is more than just a bus trip; it is a total journey (from door to door) and judged in terms of access, convenience, travel time and comfort. Network design should take this into account and involve all aspects of route planning, passenger waiting facilities, ticketing, bus quality, service frequency, comfort and convenience in the planning process.

For a 'demand oriented system', passenger convenience is the main issue, being that the system can be used with ease and ultimately saves the user time.

This concept needs to be embedded into policy objectives and the design and management of the system including features such as:

- Good network design;
- Convenient bus transfer facilities;
- Common ticketing and fare integration;
- Reduced travel time (bus speed & passenger transfer facilities);
- Passenger information;
- Modal integration.

**Bus priority**

There are numerous forms of bus priority that are relevant and applicable in various conditions, but success is only achieved through developing a system that can perform to the required standard (efficient speed and service delivery) and where management structures assign risk and accountability prudently and traveler's needs are met terms of reliability, safety and convenience. In most cases

planners must find contextual solutions to finely balance multiple and competing objectives without interfering with the essential objectives of BRT that must be met to ensure its success.

*Increasing bus speeds*

Traffic congestion has a severe and detrimental impact on the viability of bus services. Maintaining good average speeds for buses is an essential improvement to ensure a productive bus fleet and reduced commute times for passengers. Measures to improve bus-operating speeds have many benefits, as described in **Figure 9.2.3.**

The direct revenue /cost benefits for the operator are:

- Faster travel speeds attract more passengers thereby generating extra patronage (and therefore) revenues;
- Revenue per bus (per day/per km.) is boosted as the number of passengers per hour is increased. This has the effect of increasing bus system capacity and productivity;
- Costs are reduced as number of buses required to maintain headways is reduced along with the associated personnel costs, running costs and vehicle overhead costs (saving the number of extra buses that are used to replace buses held up in traffic).

There are also longer term benefits gained for the city:

- Increasing bus revenues will stimulate investment in bus technology (better quality buses and cleaner emissions) resulting in passengers benefits of comfort and convenience;
- A better bus system will result in offering better public transport as an option of choice;
- Energy and environmental benefits are also realized by more people using an efficient transport option.

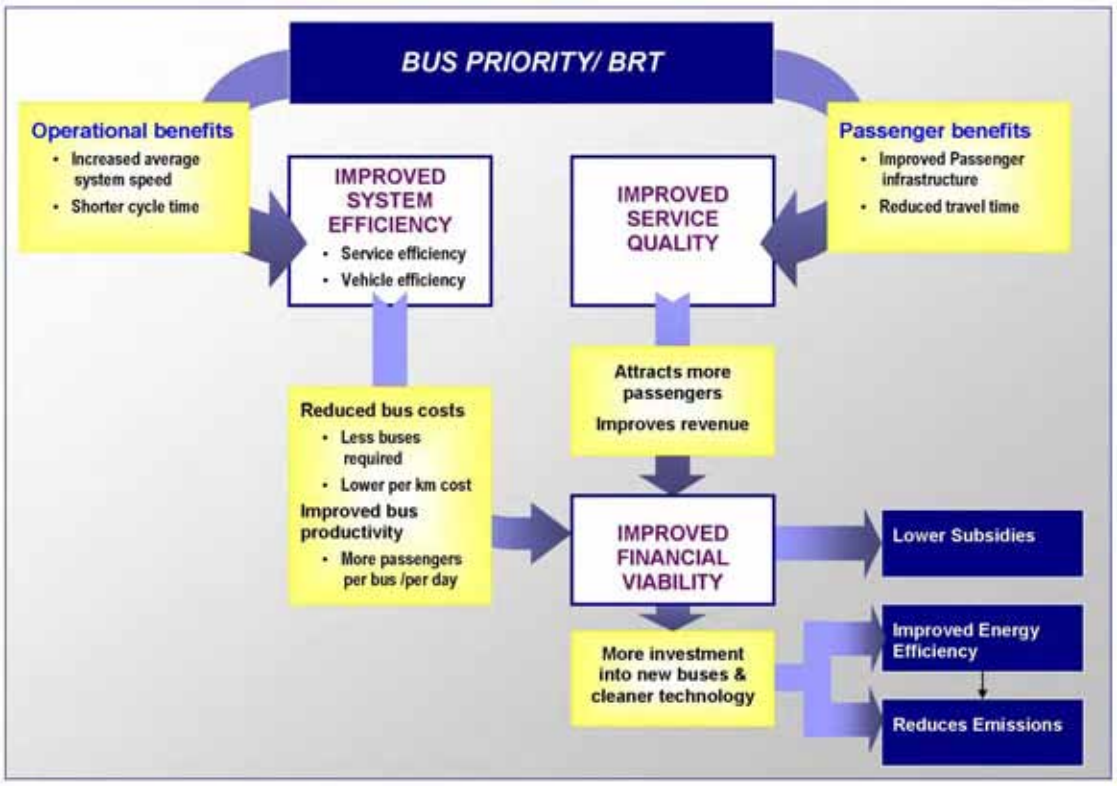



**Figure 9.2.3 Benefits of increasing bus speeds**

Each city must develop its own strategic approach for Bus Priority and BRT as part of the total system network. BRT is not an 'off the shelf' bus solution; it needs to be carefully adapted to the prevailing conditions, but in Dar es Salaam, high public transport dependency creates a natural opportunity for a BRT system.

*Reducing travel time*

For the bus system to provide efficient mobility to the community and be an attractive option, requires that it has the ability to provide time savings. Traffic congestion may be an unavoidable fact of life (unless car restrictive policies are applied), so bus systems must provide a time saving transit alternative.

Increasing bus speeds is part of this, but also involves proper design of passenger infrastructure (bus stops, bus stations, information systems, etc). Good walking access will significantly reduce the total journey time, which for the passenger is a key comparison to car use.

Passengers often perceive waiting/delay time as higher than the actual time taken, so this is a significant deterrent to bus travel.

Better passenger infrastructure is needed, including:

- High profile bus stop areas that are attractive and provide comfortable amenities;
- Real time passenger information systems that provide information on bus arrival times and service delays;

- Designs and amenities that address personal safety considerations (telephones, lighting footpaths, safety barriers and access ways);
- Easy-to-use fare collection systems and integrated (common) ticketing;

Well located designs that consider 'ease of transfer' between services.

**Accessibility and integration**

One of the strongest benefits of bus services over rail services is its accessibility yet it generally compares poorly to the level of accessibility offered by private car use. Accessibility involves route and network design but also involves aspects of physical and system integration.

Accessibility can be defined in two ways, being firstly the level of access to the system (ease of access to bus services and affordability) and secondly, once on the system, whether the destination can easily be reached.

Improving accessibility therefore requires:

- Good network design – bus services routed close to homes and dwellings & destinations;
- Physical infrastructure - requiring 'people friendly' designs for bus stops and waiting areas, with convenient transfer points and bus interchanges to provide 'seamless' transfers (ticketing equipment, safe pedestrian walkways, and passenger amenities). It is also a good idea to provide more interchange points throughout the network and have less dependence on large and bust bus interchanges (i.e. being able to transfer at bus stops).
- Appropriate and affordable fare structure and ticketing systems;
- Integration - being the extent to which the various types of service are part of the whole public transport network.

The provision of system infrastructure including passenger information systems (integrated fare systems, timetables and real-time passenger information).

**Route Network design**

The actual design of routes is an important aspect of accessibility but must also be designed so that the system is easy to understand and use. Route design is a careful balance between creating direct travel options (point to point) and developing system efficiencies to ensure that bus hours are optimally used. Therefore, the network must be easy to use, provide direct travel for the high use corridors, and provide easy transfers for lesser used travel options. Provided bus transfers incur no extra cost and are easy to negotiate; they should not act as a disincentive to system use.

The design principles of a new route network involve the following:

- Intuitive and easy to understand
    - Simple network design (BRT trunk, Secondary & Local Feeder routes

  - Orderly and intuitive route numbering system
  - Reduce the number of routes and duplications;
- Network Integration
  - Physical (managed interfaces)
  - System (distance – based fare integration/ no penalty for transfers)
- Accessibility & coverage
  - Can I access the system and then once on it reach my destination easily?
  - Access to main attractors (distributors for inner city circle routes);
- Demand oriented design
  - High demand routes direct
  - Lesser demand easy transfer
- Fleet efficiency
  - Implement bus priority to increase bus speed and reliability.

**Integrated fares and common ticketing**

From a passenger viewpoint, having a distance-based, unified fare across the network offers ease of use and a cost saving. This 'common ticket' is based on zonal fare structure where the passenger pays only for the distance traveled. In effect this means that a user pays an 'entry' fee to the system and can use the system on any number of services to complete the journey.

Modern ticketing systems can easily accommodate complex fare configurations and adapt to various requirements. It provides significant user benefits for convenience and ease of use, and it also provides essential ridership data for revenue control and system planning. With the planned BRT system, the secondary and feeder buses can be fitted with ticket machines to allow free transfers within the system onto the BRT and vice versa.

### 9.2.4 BRT Operator Frameworks and Business Model

Technical Report 3 outlines a full discussion on the operator business model and the institutional frameworks to cover service delivery. Primarily the success of the service delivery performed by the operator is highly dependant on the risk assigned between the network (system) manager and the individual operator, Risk exposure will influences operator behaviour and the incentives created by a proper business model will ensure the operators perform in the interest of the network and not just their own survival.

# Chapter 10 Review of Proposed BRT Operational Plan

## 10.1 Background

The platform of public transport reform in Dar es Salaam is the proposed BRT development under DART. This has been managed by the Project Management Unit (PMU) since 2004 and recently the DART Agency has been formally established as an Executive Agency to implement and manage the system.

Under the PMU the operational plan for the BRT has been completed as well as preliminary designs for the infrastructure. The plan covers three main areas, being the infrastructure design (in the physical location), the network plans (the service plans) and the organizational and institutional management plan.

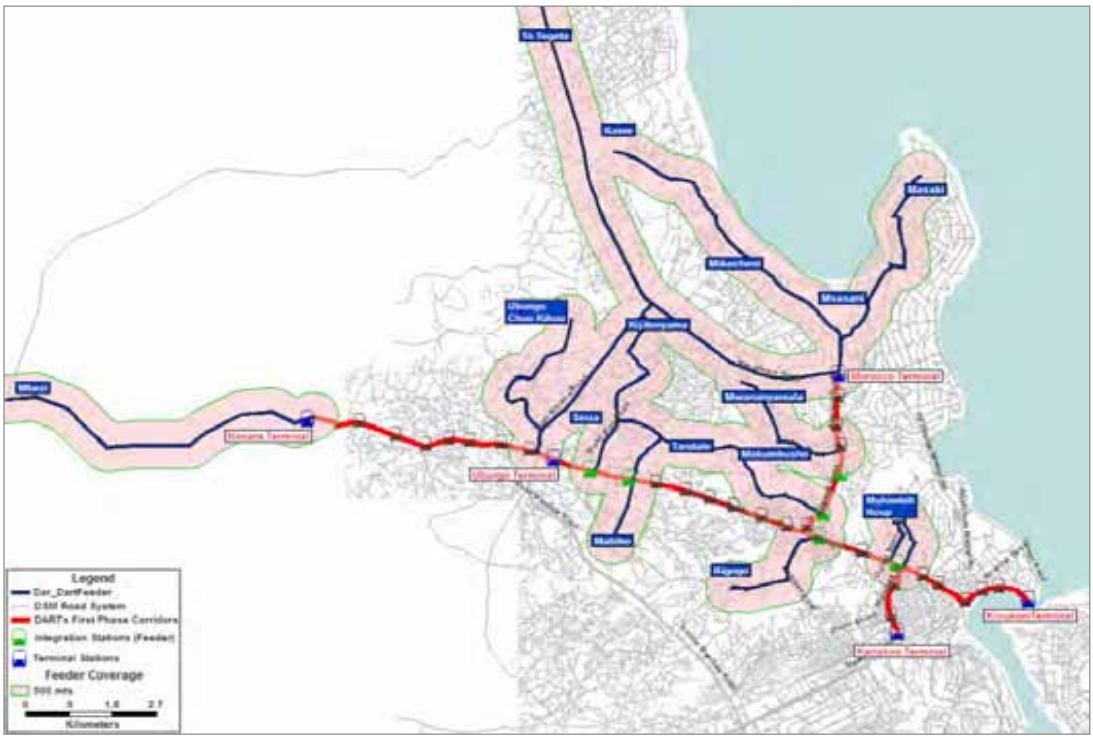
This section will conduct a brief review of the service plan and outline where such plans may need modification in the light of a wider overall network as proposed under this study.

*Chapter 14* will review the some present infrastructure design issues as they are impacted on by the network service plan.

## 10.2 Phase 1 Development

This Phase 1 BRT Corridor is proposed along Morogoro Rd from Kimara to Kivukoni and connecting Morocco and Kariakoo. The Phase 1 construction is planned to commence in 2008 with completion late 2009/early 2010. The plan comprises a comprehensive approach to developing a bus based mass transit system and represents a world class design aptly suited to the high public transport demand in the city.

The DART consultants prepared a comprehensive operational plan which provides the blueprint for implementation for the complete implementation of Phase 1 as the inaugural development. Its scope of work covered the planning and design of a successful BRT corridor which has been comprehensively addressed with the Phase 1 plans and the supporting feeder bus network as shown in **Figure 10.2.1.**

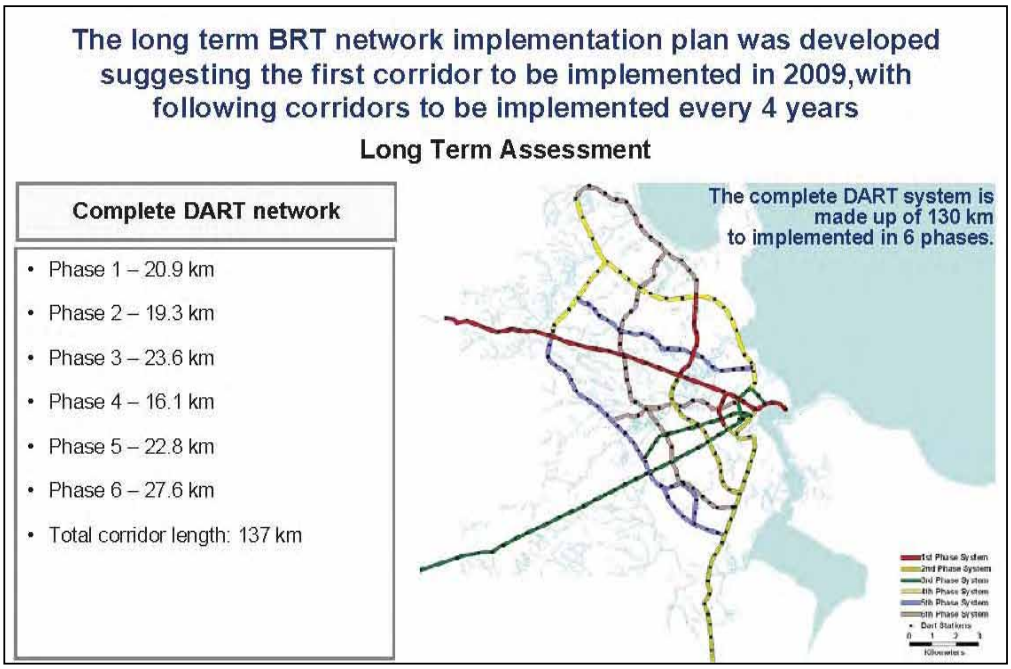



Source: Logit/ITDP Executive Report

**Figure 10.2.1 BRT Phase 1 and Feeder Services**

## 10.3 Long Term Network Plans

**Figure 10.3.1** shows a broad overview of the anticipated network by 2027 but this appears conceptual with little detailed planning evident in this full network proposal.




Source: Logit/ITDP Executive Report

**Figure 10.3.1 The Original DART BRT Network Plan**

## 10.4 Integration Issues

The proposed BRT Phase 1 plans a trunk routes/ feeder routes concept which will adequately serve the needs of the BRT corridors and the immediate environs, but would rely on the full BRT network being developed before wider parts of the city were served. The trunk/feeder interface also raises a number of integration issues, where a high number of concentrated passenger transfers become problematic, causing:

- A high dependency on interchange terminus facilities where large numbers of daladala and feeder services interface with the system;
- Passengers being required to walk to the median bus station to make the transfer causing traffic problems where 'at-grade' pedestrian crossings are used.

The route development work in this study aims to address these integration issues through a wider network plan.

## 10.5 The relationship to the Master Plan to the BRT planning

The public transport network development proposed under this Master Plan Study will complement the current BRT planning, support it and widen its development across the entire study area. It will also refine some aspects as they can be adjusted to adapt to the larger picture.

The study will revisit the phased implementation plan to look at speeding up BRT development into a full network, not just by bringing forward the building program, but by developing an earlier city-wide network of secondary routes that can easily transpose to BRT as construction is completed.

Specifically the development of an integrated network plan will include:

- Incorporating the current BRT plans and proposal as an integral part of the full Public Transport Master Plan;
- Synchronize development with the proposed road classifications and urban development scenarios;
- Use of varied bus service types to integrate better into the transport environment including complementary BRT services and secondary bus routes as well as the feeder routes;
- Creating an early functional network to support BRT and work to mitigate likely traffic impacts as road space is reassigned to public transport.;
- A strong objective approach to route design so it develops into an effective efficient and sustainable network that meets passenger demand at affordable costs and achieved financial viability as a system.

# Chapter 11 Bus Route Network Development for Dar es Salaam

## 11.1 Introduction

The bus route network for Dar es Salaam is largely dictated by the route design of the BRT with Phase 1 BRT being the 'spine' of the service in the initial stages. A supporting bus route network is essential to support the BRT system, as well as provide services across the wider city and urban areas.

This section discusses such a network plan based on accepted planning principles and with the objective of providing an integrated service capable of offering convenient and seamless travel typical of a true mass transit network. System integration will be specifically addressed, as a way of ensuring that the various service types work together to maximize passenger convenience and service efficiency.

## 11.2 Planning Principles for Route Design

Route design is fundamental to meeting passenger needs, as its efficiency will influence ridership (revenue) and manage costs efficiently. The three main planning objectives are to:

1. Create a network that will satisfy existing and future travel demand in terms of coverage and accessibility and reduces travel time;
2. Design a network that is easy for the passenger to understand and use, with a clear route hierarchy that has:
    - Primary trunk routes of BRT, the secondary bus network and feeder routes;
    - A clear origin-destination pattern (directness to main attractors) and easy transfer points to reduce the number of routes and duplications;
3. Ensure the network is efficient in terms of fleet utilization and can offer the flexibility to adjust services to meet demand while maintaining high load factors.

These objectives will require a network plan that can maintain a balance between providing a high level of direct service for high demand routes and for lesser demand journeys offer convenient passenger transfer points. Integrated ticketing across all services means that passengers are not penalized for changing buses to complete a journey.

Specifically the route network must deliver:

- Strong origin- destination pattern connecting major and popular destinations;
- Proper spacing between bus routes and less route duplications;
- Suitable bus transfer points to provide connectivity with other modes (taxis and para-transit modes where necessary);
- Use of a route numbering system that is orderly, directional and geographical;
- Determine suitability of service for road geometry and bus priority along high use corridors.

## 11.3 Integration and Development of a Bus Network

Bus route network development must enable the integration of the BRT system into a complete network to provide seamless travel and network benefits for passengers across the system.

'System integration' involves both physical integration, where services blend together to offer seamless travel across the network and system integration being the use of integrated fares to ensure passengers are not penalized when transferring across services. While integration has good passenger benefits, it also can improve the financial viability of the network by attracting passengers and increasing ridership and revenue.

As mentioned previously, the proposed BRT plan has a high dependency on feeder routes and under a typical feeder bus system passengers will need to transfer to BRT by alighting at a feeder bus terminus, and cross the road to the median BRT station. There are numerous locations in Dar es Salaam, where literally thousands of passengers per hour will 'feed' into BRT stations requiring a well organized feeder terminal, and also a way of transferring these passengers to the BRT via overhead walkway or signalized pedestrian crossings.

To address this important interface issue, it is proposed to develop a network of secondary routes that can improve integration. While these are also effectively feeders to the BRT they will also provide a higher degree of cross suburb travel options and be fully fare-integrated to the BRT.

Better integration and a solution to the interface issues is designating selected secondary buses as 'complementary BRT buses' that are permitted to enter the BRT for short distances. These would operate as fare integrated secondary routes in mixed traffic and by means of an extra set of doors (at station platform height) alight passengers directly on to the station platform (on the paid side) for a direct connection to BRT trunk services. This alleviates the walking transfer and reduces the need for bus /daladala interchange facilities.

There is also the possibility of the complementary buses being used for off-peak services on the BRT as a more efficient means of transporting off-peak loads while maintaining a higher level of service frequency. **Figure 11.3.1** shows a diagram of the complementary bus interface at the station and **Figure 11.3.2** shows an alternative design for high capacity stations where complementary buses are given an indented bay to allow trunk buses to bypass.

It should be cautioned that every situation has its own constraints and the transfer and interchange

issues for each location must be evaluated independently. Also there often is no right or wrong choices, just choices that are better in terms of optimization. The complementary bus however is worth evaluating as an option for the Dar es Salaam BRT.

The BRT complementary bus routes offer an advantage in that it extends the reach of BRT influence and catchment into a much wider area. Some level of bus priority should be provides for these services (queue jumping lanes at lights and green light priority are suggested). Good quality designated bus stops are also a highly visible demonstration of service quality and availability throughout the extended suburbs.

Another benefit is that complementary buses can operate a greater distance on the busway if necessary, such as off- peak services, providing a more efficient option for low demand periods (by using smaller buses) thereby greatly increasing the flexibility of the system.

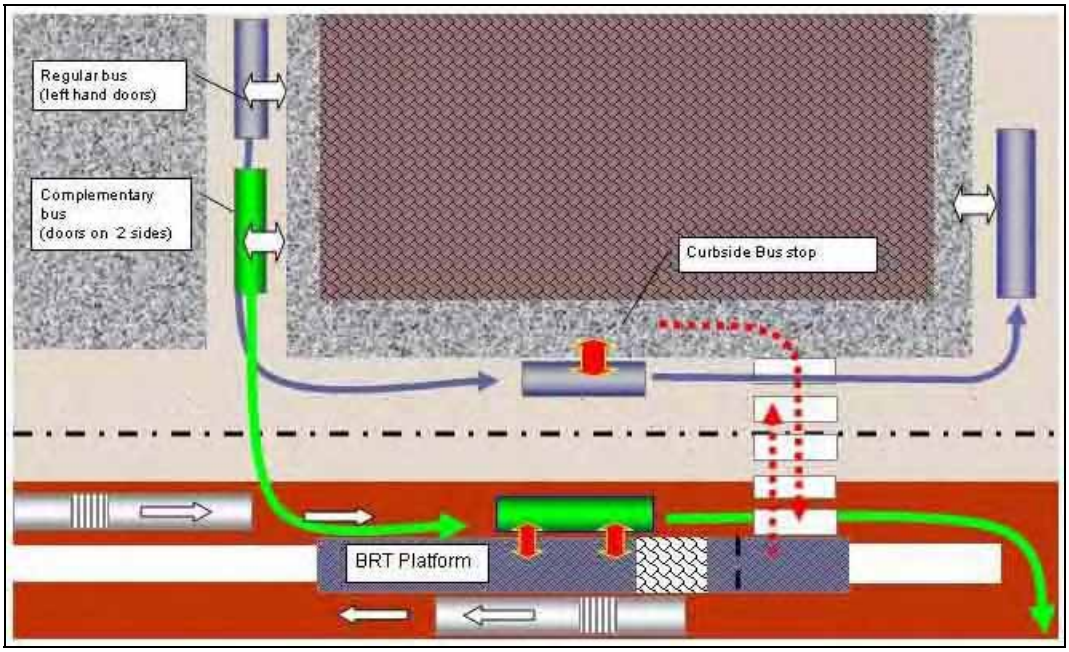



**Figure 11.3.1 Complementary bus interchange at BRT station**

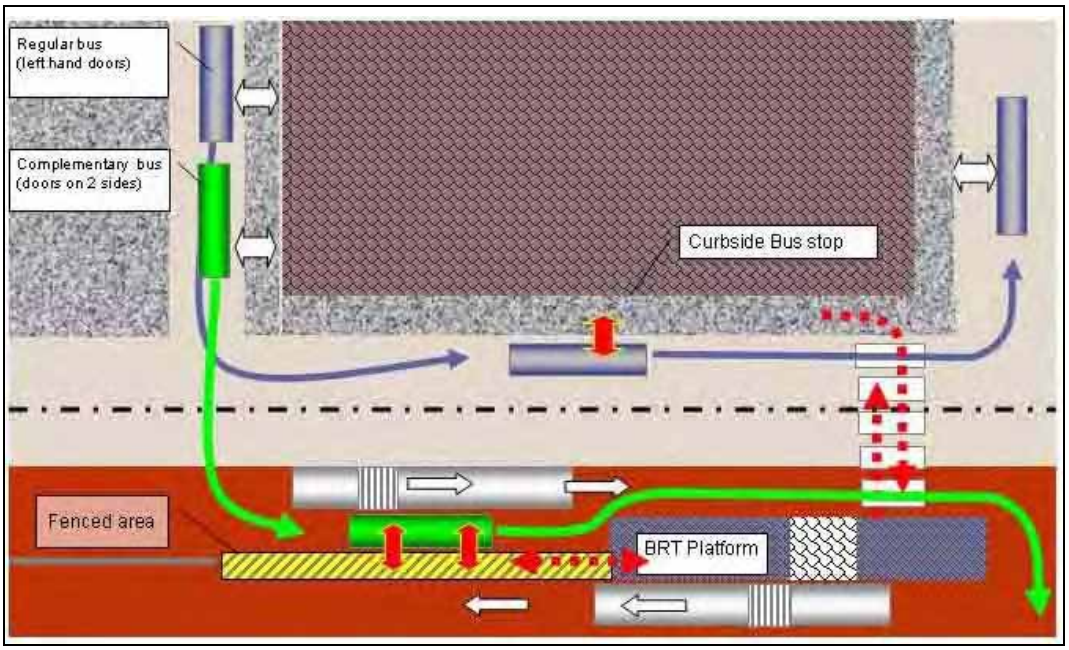



**Figure11.3.2 Alternative design which allows BRT buses to bypass.**

The efficiency and serviceability of the service design options are compared in the Decision Matrix of **Table 11.3.1**. This matrix assesses the service quality and the various levels of integration offered by each option starting with Option 1 as the existing proposed trunk/feeder system, comparing it to Option 2 being a general route network integrated to a BRT and the final and recommended Option 3 of the complementary routes fully integrated into the BRT. The matrix assesses each scenario over a range of service quality issues, demonstrating a pronounced advantage for the integration offered by a complementary bus service.

**Table 11.3.1 Decision Matrix**

| Service Type Options - Decision Matrix | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Service Quality Criteria | | | | | |
| Option S/No. | Service Combination | Level of coverage | Level of Network Integration | Ease of passenger transfer | Level of fare integration across the network | Level of cross suburb service for passengers | Level of additional service flexibility |
| 1 | **BRT Trunk lines with Feeder Routes** | **Medium Low** | **Low** | **Medium** | **Low** | **Low** | **Nil** |
| | *BRT has dedicated feeder routes - Cross suburb regular bus connection incidental* ***(Existing Dar es Salaam Plan)*** | Only within 5km of BRT | Feeder bus routes free or are partially subsidised to offer fare relief for transfers. Regular routes are not integrated | Passengers walk from curbside feeder buses to BRT stations | Only feeder routes are fare integrated | Requires interchange to other feeder buses | BRT and Feeders are two distinct and separate services |
| 2 | **BRT Trunk lines connected to regular bus routes and feeders** | **High** | **High** | **Medium** | **High** | **Medium High** | **Nil** |
| | *Regular buses are part of the feeder network with fare integration* | Provides full network coverage of regular bus services that connect to BRT | Provides adequate network benefits but needs to be fully 'fare integrated' | Passengers must walk from curbsides to BRT stations | High when fares integrated **Low** when not integrated | Time penalty for bus transfers to other feeder services or regular bus network | BRT buses and network/ feeder buses are distinct and separate services |
| 3 | **BRT Trunk lines with complementary routes and feeder routes** | **Very High** | **Very High** | **Very High** | **High** | **Very High** | **High** |
| | *Complementary Bus priority routes are physically integrated by having RHS doors for transfers to BRT and fares are fully integrated* | The secondary routes extend a higher level of benefits across a wider network | Total integration in physical terms as well total fare integration | Platform transfers on the 'paid side' of the BRT platform is a 'seamless' transfer | Total integration across the entire network | Fully integrated with cross suburb routes provides a complete matrix of area coverage | Complementary buses are 'BRT compatible' and can be used on the BRT network at off peak times for greater fleet efficiency and cost savings. |

## 11.4 Description of Service Types

The bus network design identifies different 'service types' as follows:

**BRT trunk line:** Buses that operate exclusively on the BRT (15 metre or 18m articulated buses).

**BRT complementary buses:** 12m or 15m buses that operate along regular bus routes (that also may have some measures of bus priority treatments) but can also enter the busway and service the station platforms. These buses will have 2 doors on the left-hand side for curbside pickup and 2 right-hand doors for station access.

**Secondary buses:** 12 m city buses that operate regular bus routes (but do not enter then busway). These routes also service areas other than busway connections.

**Feeder services:** being the smaller buses (30 seats or less that provide short feeder services to the BRT).

## 11.5 Route Network Design for Dar es Salaam

The study has prepared a complete bus network for the study area involving five phases of BRT introduction up to Yr 2017. At each phase of implementation routes are added and in some cases secondary routes are replaced by BRT trunk routes. The following section describes the logic behind the implementation as well as the description of routes and implementation constraints.

### 11.5.1 Passenger Demand

The route design is substantially based on existing demand figures which has informed the route design, identifying which services require direct connection and where a transfer is feasible. It is surmised that the present system of Dala Dala and viphanyas operate more or less to demand (as they respond to patronage demand in high volume routes) and this then provide an indication where demand lies. However a logical approach is also used to connect known attractors with origins to reduce the need for the forced passenger transfers caused presently where daladala operate strictly between termini. The new plan focuses on a high level of accessibility and connectivity in the system.

### 11.5.2 Accessibility and Connectivity

The route design has followed high demand routes, to ensure a large proportion of travelers are able to make a more or less direct trip with minimal transfer necessary. However for lesser demand trips the network gives the option for passengers to transfer at many points where routes connect (not just at terminal stations) so it offers the benefits of a true network. Any BRT station or bus stops where routes align to offer a transfer point with actual examples shown as **Figure 11.5.1**.

**Figure 11.5.1 Schematic of route design showing typical transfer options along the route**

For the Phase 1 BRT there have been numerous interchange points identified where the secondary and complementary buses touch the system as shown in **Figure 11.5.2.**

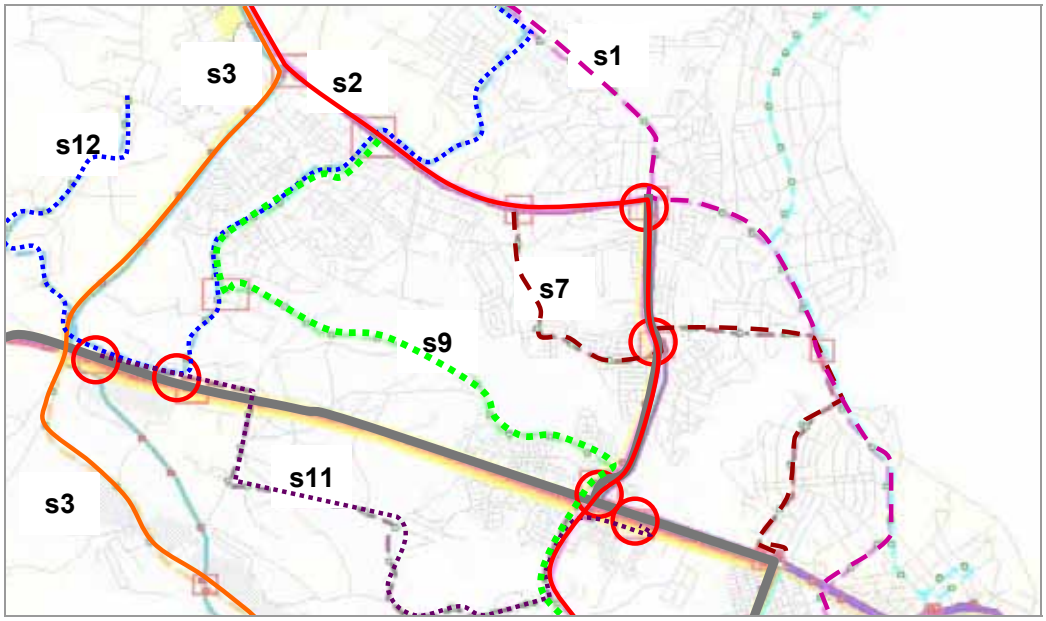



**Figure 11.5.2 Major Interchange Points with Phase 1 for Secondary Routes**

## 11.5.3 CBD Circulation and Tidal Bus Priority

A full discussion of the public transport routes for the City centre/CBD is contained in *Chapter 7* of this report, but a brief outline is provided here in reference to the proposed concept of developing a tidal bus priority lane for the bus traffic along Ali Hassan Mwinyi Rd south of Selander Bridge. This is a major and essential initiative to reduce car traffic as part of the CBD traffic management strategy. Such a plan will require the development of a central road tidal flow bus priority lane (AM inbound /

PM outbound) for the bus traffic along Ali Hassan Mwinyi Rd commencing north of the Selander Bridge to the intersection of Ohio Rd where it crosses directly via a signalized bus-only lane to Upanga St (presently closed off) and then turning left at Azikiwe St (Posta), then via a one way loop Garden St, Mirambo St, Samora Ave, left to Akiwize to Sokoine Drive to interchange with BRT (front of NBC bank by doing a loop around the triangular park) and then return directly to Posta and right into Upanga St to head north. Opposing bus traffic to the bus priority direction will return via mixed traffic. The secondary S5 route from Msasani Peninsula is designated for this route.

The secondary S3 route from Kariakoo will travel via Bibi Titi, right into Maktaba/Akiwize to Posta and follow the same one way Mirambo loop as the S5. The Mirambo loop being a one-way bus loop will require the mixed traffic to also be controlled as unidirectional with bus traffic as illustrated in **Figure 11.5.3.**

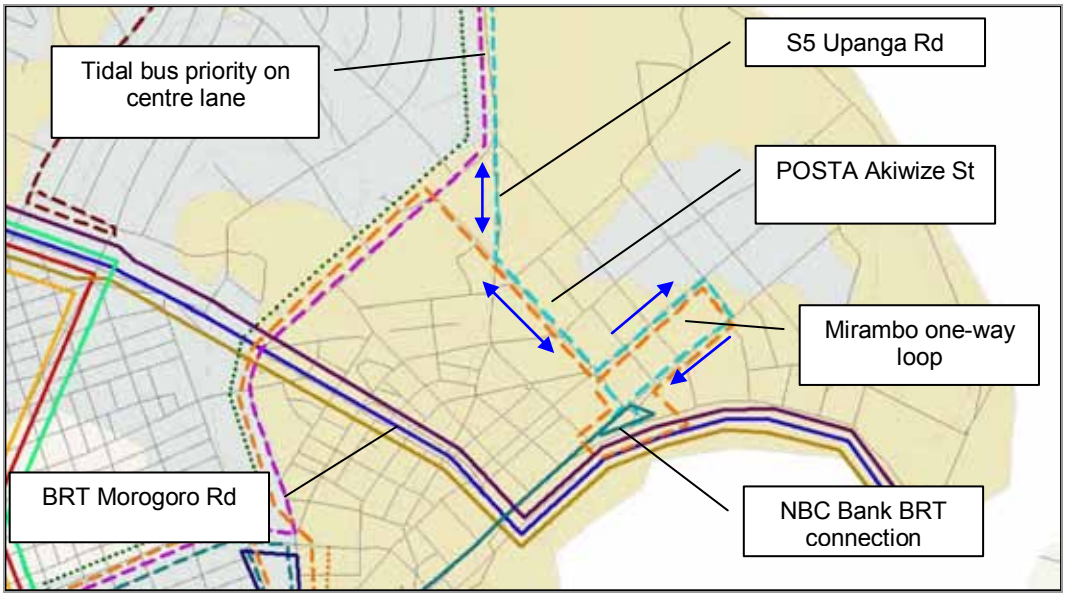



**Figure 11.5.3 CBD Circulation**

## 11.5.4 TRL Rail Corridor

An integral part of the Phase 3 BRT implementation is the use of the existing (mostly disused) rail corridor that runs from the city rail station, crosses Nyerere Rd and runs parallel to the Dodoma line before veering north at Tazara /Bugurundi to Tabata and Ubungo. This line was previously in disuse but has recently (2008) been reinstated to transfer shipping containers to a holding yard at Ubungo under a concession from TRL to the RITES company.

This line cuts through an area west of Nelson Mandela Rd that is densely populated with very poor public transport options. Developing this section of rail line into a BRT mass transit line would both create an excellent connection to the city from these western suburbs offering a number of clear advantages to urban transport development. These are:

- Offers direct access for the Bugurundi area to a BRT line as the Nyrere Rd BRT is on the

opposite side of the main rail line.

- Removes the proposed BRT off the Nelson Mandela Rd, retaining it as a major truck route and using the TRL corridor as the mass transit corridor.
- The section of the TRL line operating from Kariakoo to the City Rail station (crossing Nyerere Rd) when used as a BRT mass transit connection, reduces pressure on the southern entry point to the city by diverting the BRT lines onto a dedicated mass transit alignment. Routes from the Nyrere Rd, TRL line and Kilwa Rd would all use the TRL connection between Kariakoo and the City Staiton.
- The City Rail station would need to be relocated to the Tazara area with a connection to the BRT network. This reduces rail crossings in the inner precincts of the city and connects the wider city to the Rail station with the BRT.

It is therefore recommended to negotiate the use of the TRL line with the concessionaire, as the value of the corridor as a mass transit link (potentially carrying 4,000-5000 passengers per hour) is far greater than using for occasional freight use. The use of the Nelson Mandela truck route to freight containers to a container terminal located west of Nelson Mandela Rd would be a far more efficient logistical solution for container freight.

The construction of the busway itself along the TRL line would be a relatively simple construction to a dual carriageway for most of the route. However, some small sections are raised and may need some earthworks to create the necessary width (See photos in **Figures 11.5.4 - 11.5.7**).

If corridor width is restrictive, passing lanes are optional as this is likely to be an all-stops service (being a suburban sweep and not a major arterial BRT route) or there exists the possibility to build passing lanes at minor stations (where space may be available) so some services can by pass these stations.

**Figures 11.5.4 & 11.5.5**

**Showing unused rail corridor along Buguruni Section**

**Figures 11.5.6. & 11.5.7**

**Showing deviation into potential BRT depot site at Ubungo and a narrow section along the Tabata section**

The 3 required flyovers are a major component of this construction at the locations shown on **Figure 11.5.8** and also includes a 3-way flyover across Mandela/ Nyerere Rd. Also an access connection to the BRT station at Ubungo needs to be constructed to provide a seamless connection. These flyovers and access to Morogoro Rd are imperative and essential to the success of the line operation.

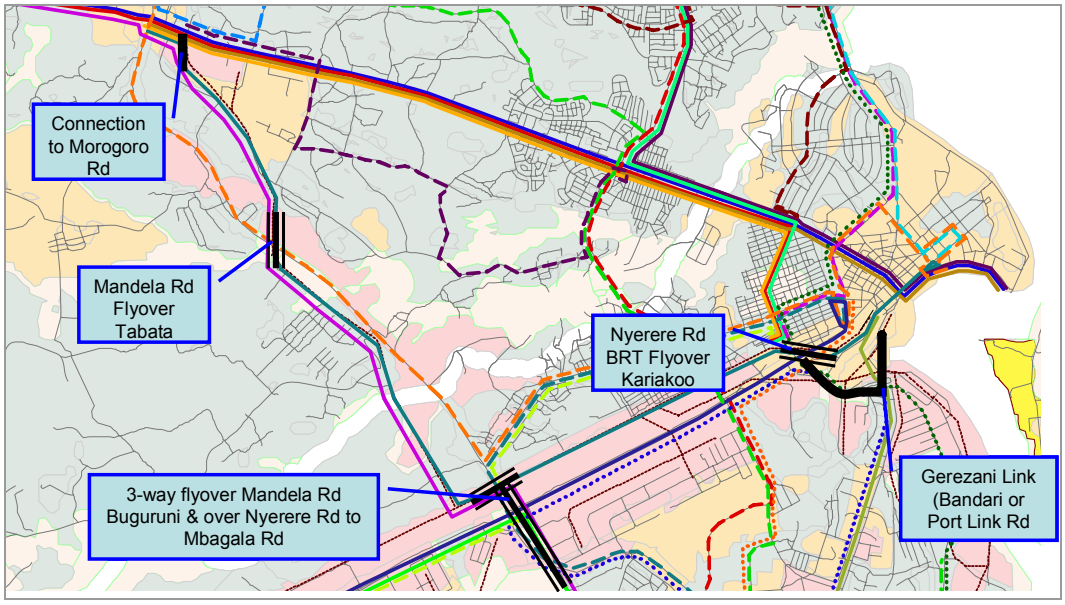



**Figure11.5.8 Flyover Locations for TRL Line**

## 11.5.5 BRT Route Numbering System

Passengers will quickly become accustomed to the route system where the route numbering system is intuitively associated with area and corridors. While initially this appears a little confusing, passengers will quickly associate the route numbers with their area and direction. For the BRT routes only, the logic is a three digit number where the first number denotes area serviced (origin) the second number being the main corridor traversed and the destination is denoted by the third number. The list of

numbers and some examples are outlined in **Figure 11.5.9** with **Figure 11.5.10** showing Phase 1 examples.

The secondary routes at this point are just given an alpha numeric label (*S1, S2* etc) for the sake of simplicity. Where these routes are modified during network development they may be allotted a suffix (e.g. 'm' for modified or 'ext' for extension).

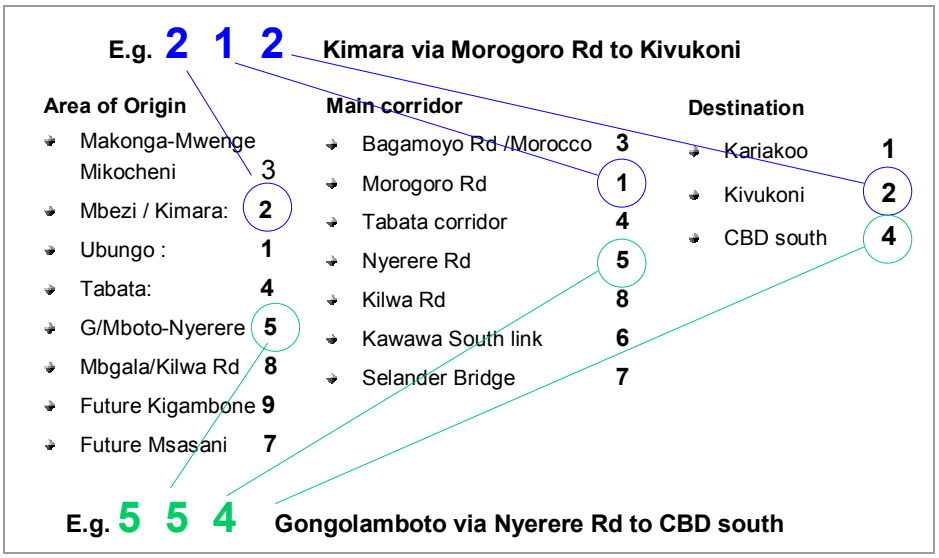



**Figure 11.5.9 Explanation of route numbers for BRT routes**

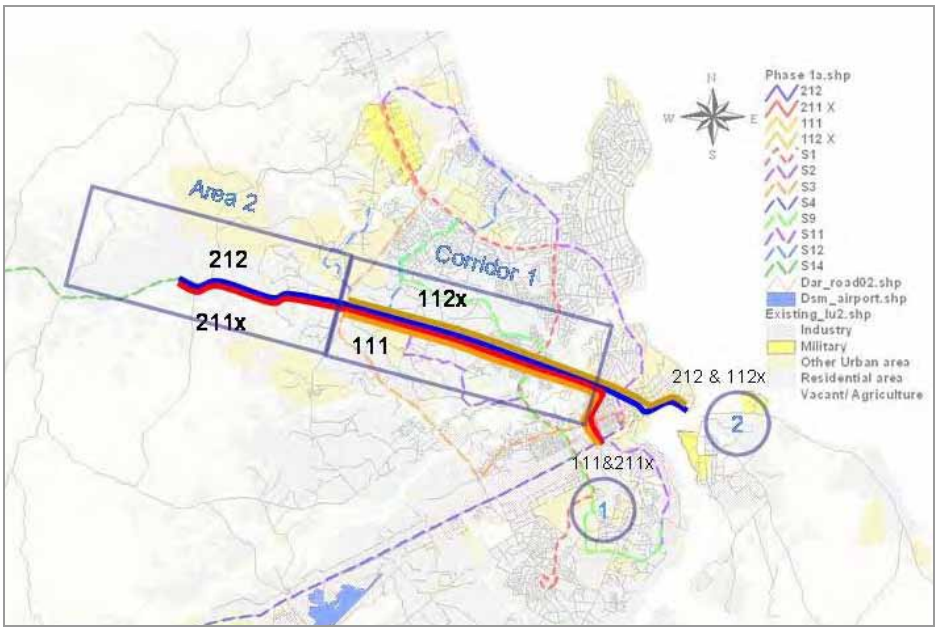



**Figure 11.5.10 Examples of route numbers for Phase 1 BRT**

A complete route design (2015) is shown as **Figure 11.5.11** and a 2030 route design is shown as **Figure 11.5.12.**

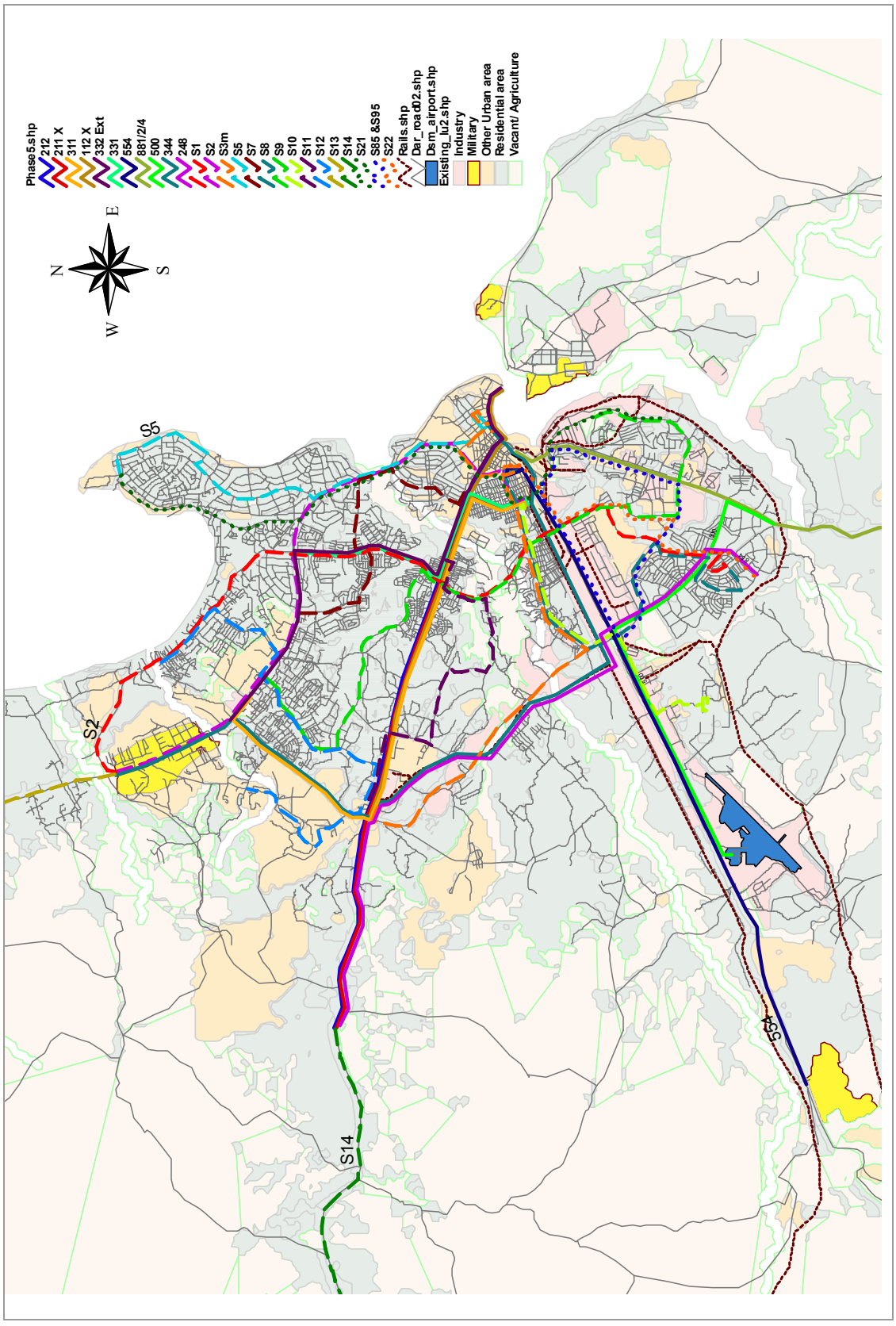



Figure 11.5.11 Completed Route Plan by 2015 (up to Phase 4)

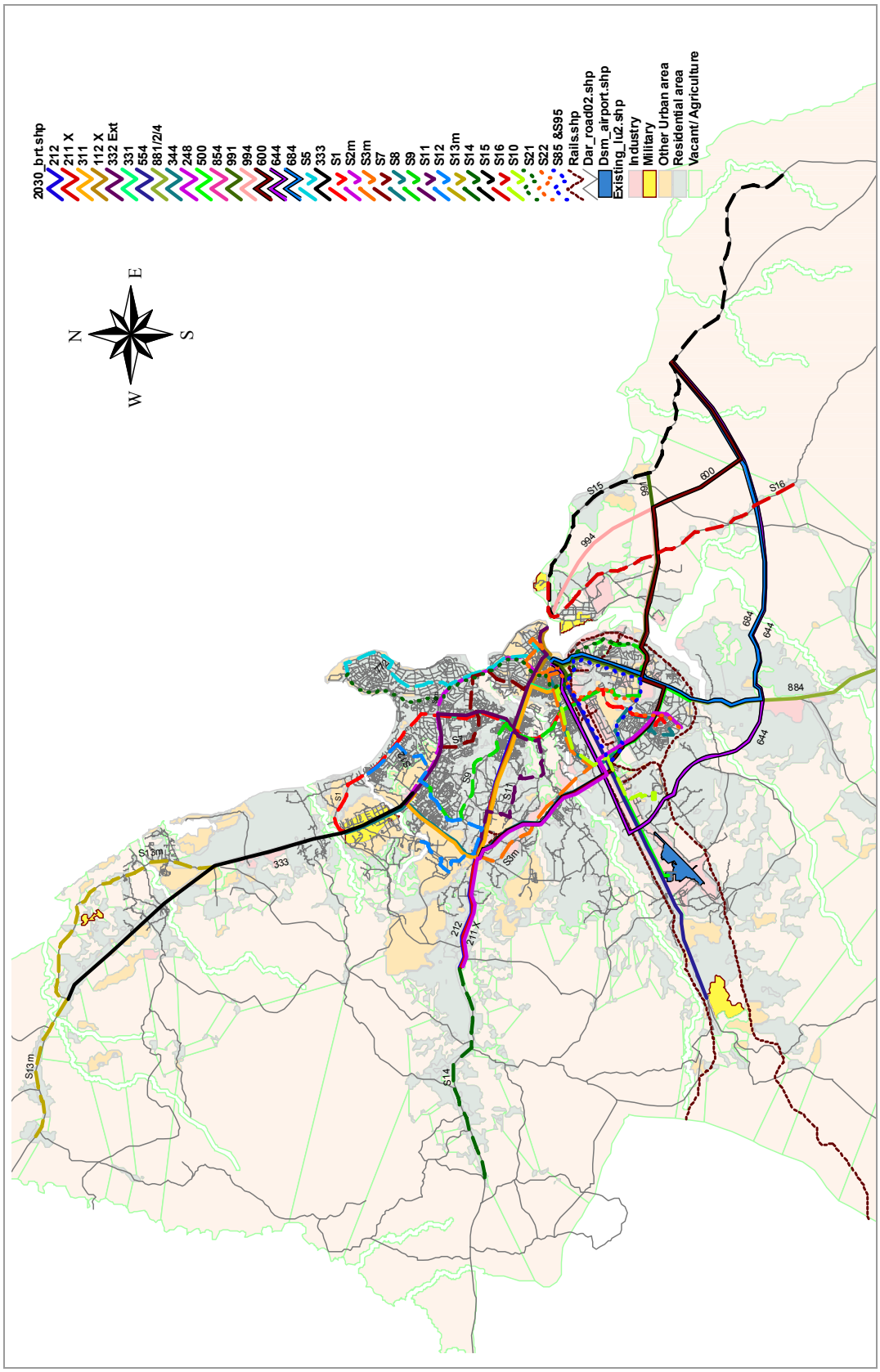



Figure 11.5.12 Completed Route Plan by 2030

## 11.6 Phased Introduction of Bus Routes

The bus route network development will follow the order of phased BRT development. These phases are reliant on road construction and in some cases require flyovers to ease the intersection and traffic conflict issue.

With the high proportion of bus travel in Dar es Salaam, the early development of an efficient bus system is critical to improving the commuting experience and the quality of daily life. The payoffs in financial, economic, social terms will more than justify an accelerated investment into the public transport infrastructure. Consequently the full plan (to Phase 5) is proposed to occur by 2017.

Presently the committed BRT development is for the inaugural Phase 1.

Following the completion of a complete *Phase 1*, the sequence of BRT system expansion for future phases depends largely on the corridors being prepared, namely:

1. Having available space within the road reserve. The only proposed corridor with available space presently is Nyerere Rd (as at 2007) but the Gongolamboto section will need road construction.
2. Completing road widening projects according to the anticipated timetable as follows:
   - Sam Nujome Rd – early 2008.
   - Kilwa Rd – early 2009.
   - Old Bagamoyo Rd – 2011.
3. Securing corridor availability, specifically the Ubungo – Tabata disused rail corridor to the CBD which has been proposed by the study team for a 'changed-use' scenario to utilize it for a BRT route. This corridor is presently under a TRL concession requiring negotiation for its use. The timescale for this decision is unknown, but with some political will to improve public transport in the western suburbs it may be possible to expect a resolution during 2008- 2009. If this occurred it would allow a relatively early introduction.

A number of flyover infrastructures need to be developed as part of the BRT thoroughfares, namely the BRT flyovers crossing Kariakoo/ Nyerere Rd intersection, Mandela Rd (at Tabata and at Buguruni) and the option of an BRT elevated road being built across the Port area (a Port Link) to provide a direct link to the Railway St Station and the CBD.

Based on the estimated road construction timetable / availability scenarios the phases of BRT introduction are estimated according to **Table 11.6.1**

**Table 11.6.1 BRT Development Phasing**

| Section | Availability | BRT introduction |
|---|---|---|
| Phase 1A: Kimara to Kivukoni & Kariakoo) | 2007 (Committed project) | End 2009 |
| Phase 1B: Morocco extension | 2007 (Committed but funding required) | 2009 |
| Phase 2: Nyerere Rd | 2007 (Available corridor) | 2012 |
| Phase 3A: Kilwa Rd (can be Phase 2) | Mar 2009 +1 yr BRT and requires elevated BRT to CBD | 2013 |
| Phase 3B: Ubungo–Tabata Rail Corridor & Mbgala Rd Link | 2009 (subject to negotiation ) | 2014 |
| Phase 4A Sam Nujome Rd Phase 4B Bagamoyo Rd | 2011 (Completed roadwork) | 2015 |
| Phase 5 | Requires a bridge to be constructed to Vibijweni / Kigamboni - extension of Nelson Mandela Rd | 2015-2020 (2017) |

## 11.6.1 BRT Phase 1: Morogoro Rd to Kivukoni & Kariakoo

**Phase 1 Corridor Description**

This is the inaugural BRT trunk corridor along Morogoro Rd operating from Kimara to Kivukoni and branching to Kariakoo. Land resumption is underway (2007/2008) and assuming a 12 + month build-period the completion is expected late 2009. The Morocco section operates from Magomeni Mapipa along Kawawa Rd North. **Phase 1Construction Issues**

The main issues to address for the Morogoro Rd corridor are as follows:

- The proposed traffic management plan at Ubungo which disallows turning traffic across the busway through the limitation of a 2-phase signal is likely to cause problems for general traffic and ultimately the BRT as the u-turning alternative will increase cross-traffic considerably. The same issue applies to Kawawa Rd intersection. This study has modelled alternatives to the proposed plan and various infrastructure alternatives such as grade separation are discussed in *Chapter 5*. BRT signaling treatments are discussed in *Section 5.2.6*
- It is likely that with an improved integration of secondary routes that the extensive infrastructure (proposed) for some of the daladala interchange may not be necessary. See further discussion in *Chapter 14*
- An increased use of secondary bus routes will also impact on the volume of CBD daladala traffic movements in the CBD. A revised CBD traffic plan that accommodates secondary bus services is discussed in *Chapter 7*.
- Significant reduction in long-distance bus traffic could be obtained by locating the Ubungo long distance bus station towards Kimara in order to avoid the Ubungo intersection. However this would be a long term option.

- Detail design for this section is completed so there are no construction issues outstanding. However with the future extension of the BRT along Bagamoyo Rd, the large Morocco terminus and interchange will be largely redundant. It may be prudent to reduce the scale of construction of the Morocco terminus by terminating the route at the previous station close to the secondary school where the space exists to turn buses off-road.
- The various amendments to design my reduce construction costs allowing budgetary latitude for better intersection treatments at Ubungo and Kawawe.

**Phase 1 Route Operation**

**Table 11.6.2** lists the proposed routes for Phase 1 and includes 7 trunk routes and 10 secondary routes.

**Table 11.6.2 Phase 1 Routes**

| Phase 1 | Morogoro Rd & Kariakoo | | km |
|---|---|---|---|
| | 212 | Kimara to Kivukoni | 16.0 |
| | 211X | Kimara to Kariakoo Express | 14.5 |
| | 111 | Ubungo to Kariakoo | 9.3 |
| | 112X | Ubungo to Kivukoni Express | 10.8 |
| | 300 | Morocco to Ubungo | 9.4 |
| | 332 | Morocco to Kivukoni | 8.7 |
| | 331 | Morocco to Kariakoo | 7.3 |
| | S1 | Kawe - Mikocheni -Msasani to Tandika via Bagamoyo Rd, Kawawe Rd Changombe | 20.5 |
| | S2 | Makonga to Port via Bagamoyo Rd, Ali Hussein Rd, Bibi Tibi /Kariakoo | 20.0 |
| | S3 | Makongo - Mwenge - Ubungo - Buguruni via Mandela Rd & Uhuru St Buguruni | 23.0 |
| | S4 | Gongolamboto via Nyerere Rd to Kariakoo | 16.0 |
| | S9 | Tandale to Port via Kawawa Link & Changombe | 17.5 |
| | S10 | Kiwalani to Kariakoo via Nyerere & Uhuru St Buguruni | 8.7 |
| | S11 | Ubungo - Mabibo to Magomeni Mapipa | 9.5 |
| | S12 | Mikocheni - Kijitonyama- Ubungo - University Ubungo Chokuu | 13.7 |
| | S14 | Mbezi To Kimara | 10.0 |
| | S20 | Kimara to Tandika via Mandela Rd /Changombe Rd | 19.0 |
| | S21 | Msasani to Port via Bibi Titi Rd, Kariakoo and Bandari Rd | 16.0 |

**Phase 1 BRT Trunk Routes**

The BRT routes operate exclusively on the busway to provide a high level of reliability. For Phase 1, five trunk routes operate as all-stops services with two routes (211X as 112X) operating as express services offering a faster limited-stop service.

**Phase 1 Secondary routes**

11 supporting routes have been added to the *Phase 1A* BRT as follows:

Route S1 operates from Kawe - Mikocheni -Msasani to Tandika via Bagamoyo Rd, Morocco, Kawawa Rd, Shandrimoya St, Changombe Rd, Temeke St to Tandika. This route will operate as a future complementary BRT service along the busway at Kawawa Rd (Phase 1B) North and traveling along mixed traffic routes on Old Bagamoyo Rd and Kawawa Rd South .

Route S2 operates from Makongo along Bagamoyo Rd, to Ali Hassan Rd (Selander Bridge) to Bibi Tibi Mohammed Rd, Uhuru St to the Kariakoo BRT terminal.

Route S3 operates from Makongo via Bagamoyo Rd, Sam Nujome Rd, Nelson Mandela Rd, left turn to Uhuru St Buguruni, Kariakoo and via Bibi Tibi Rd, Posta to the CBD area via the Mirambo St Loop.

Route S4 operates from Gongolamboto to CBD via Nyerere Rd, Msimbazi St, Kariakoo Uhuru St Lumumba St clockwise loop returning to Nyerere Rd.

Route S9 Tandale to Port via Rashid Kawawa Sth and Changombe Rd, to Mandela Rd.

Route S10 operates from Kiwalani to Kariakoo via Nyerere and Uhuru Rds.

Route S11 Ubungo via Mabibo, Kigogo to Magomeni Mapipa (complementary bus -interchanges BRT at Ubungo and Magomeni Mapipa).

Route S12 Mikocheni to University via Kijitonyama, Shekilango Rd, and Ubungo (operates as a complementary bus interchanging with BRT at Ubungo and future BRT at Bagamoyo Rd).

Route S14 Mbezi to Kimara BRT terminus.

Route S20 Kimara BRT terminus to Tandika via Morogoro Rd, Mandela Rd (Changombe), Temeke St, terminates Chibota St.

Route S21 Msasani to Port via Bibi Titi Rd, Kariakoo and Bandari Rd

Implementing these secondary routes (operating with large buses) concurrent to the introduction of BRT increases the network coverage significantly, having the dual benefit of spreading the benefits of BRT across a wider area; and creating extra network coverage to mitigate the traffic impacts which are expected from the introduction of BRT. This will increase the options for a larger modal shift in the early stages.

The complete Phase 1 Route Map is shown as **Figure 11.6.1.**

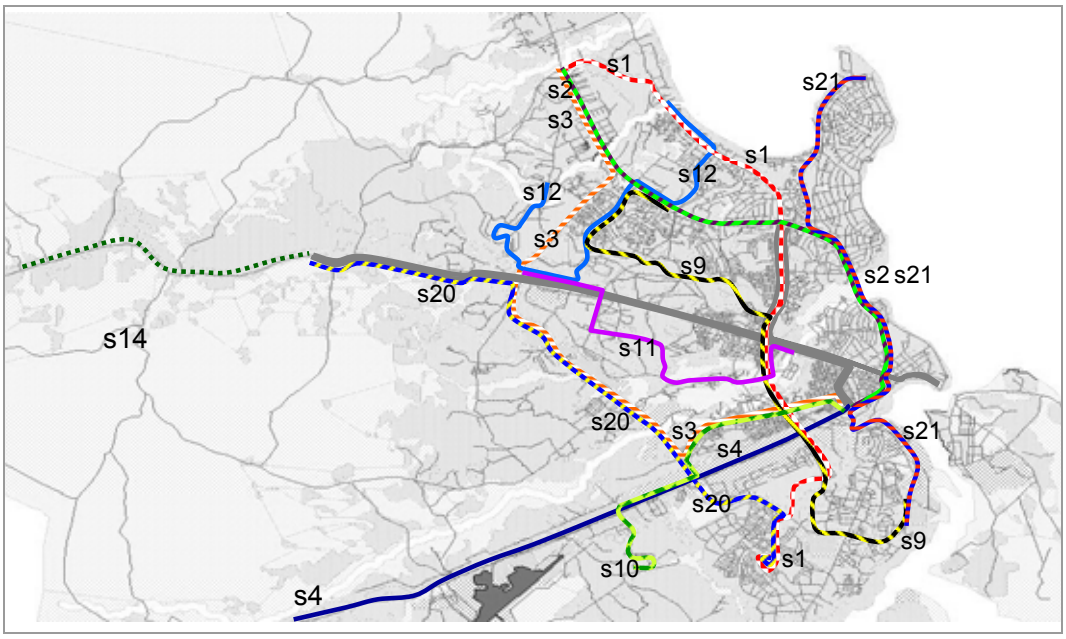



**Figure 11.6.1 Phase 1 Routes**

## 11.6.2 Phase 2 Nyerere Rd

**Phase 2 Corridor Description**

Phase 2 is the construction of BRT along Nyerere Rd from Gongolamboto to the CBD terminating at Kariakoo interchange where it connects with other routes.

**Phase 2 Construction Issues**

Nyerere Rd has been selected for an early introduction as it currently has sufficient road width for a BRT and carries large passenger volumes from Gongolamboto area thereby delivering maximum early benefit, both for passengers and to reduce CBD traffic.

To improve passenger and luggage transfer from the airport to a BRT station an overhead passenger walkway (with ramp) needs to be constructed as part of the BRT station development at the airport.

This phase includes a Secondary route implemented from Msasani Peninsula (s5) introduced to specifically reduce car use from the Peninsula to mitigate car impacts in the CBD and to make this an attractive option for motorists. It will require Bus Priority treatments in the section south of Selander Bridge to the Ohio St intersection with a priority cross-over lane constructed to Upanga St. This is discussed in Section 11.5.3. The one way traffic treatments along Garden St, Mirambo St and Samora Ave also need to be implemented for this phase to proceed.

**Phase 2 Route Operation**

The BRT routes for *Phase 2* will initially comprise an all-stops service (554) to Kariakoo replacing the S4 secondary route (See **Table 11.6.4**).

Five additional secondary routes are added in this phase:

Route S5 operating from Seacliff to the CBD via Toure Dr, Chole Rd, Haile Selassie Rd, Selander Bridge to the CBD circulation route via the Mirambo St Loop.

Route S6 servicing the airport to Mtoni via Mandela Rd. Passengers can interchange between services at any station between the airport and Changombe Rd.

Route S7 Mwananyamala-Kinindoni to Upanga Fire Station via Selander Br. & United Nations Rd. This service would operate as a complementary route as it touches 2 (and later 3) BRT stations.

Route S8 Tandika -Temeke to Kariakoo via Mandela Rd & Uhuru Rd, Buguruni.

Route S22 Tandika to Kariakoo via Shandrimoya Rd.

**Figure 11.6.3** shows the new routes of Phase 2.

**Table 11.6.3 Phase 2 Routes**

| Phase 2 | Gongolamboto & Nyerere Rd | | km |
|---|---|---|---|
| New | 554 | Gongolamboto via Nyerere Rd to Karaikoo | 16.0 |
| Remove | S4 | Replaced by BRT Route 554 | |
| New | S5 | Masani Peninsula to CBD via Selander Br. to Mirambo St loop. | 12.3 |
| New | S6 | Airport - Mtoni via Nyerere Rd & Mbagala Rd | 12.5 |
| New | S7 | Mwananyamala-Kinondoni to Upanga Fire Station via Selander Br. & United Nations Rd | 8.1 |
| New | S8 | Tandika -Temeke to Kariakoo via Mandela Rd & Uhuru Rd Buguruni | 12.3 |
| New | S22 | Tandika to Kariakoo via Shandrimoya Rd | 12.2 |

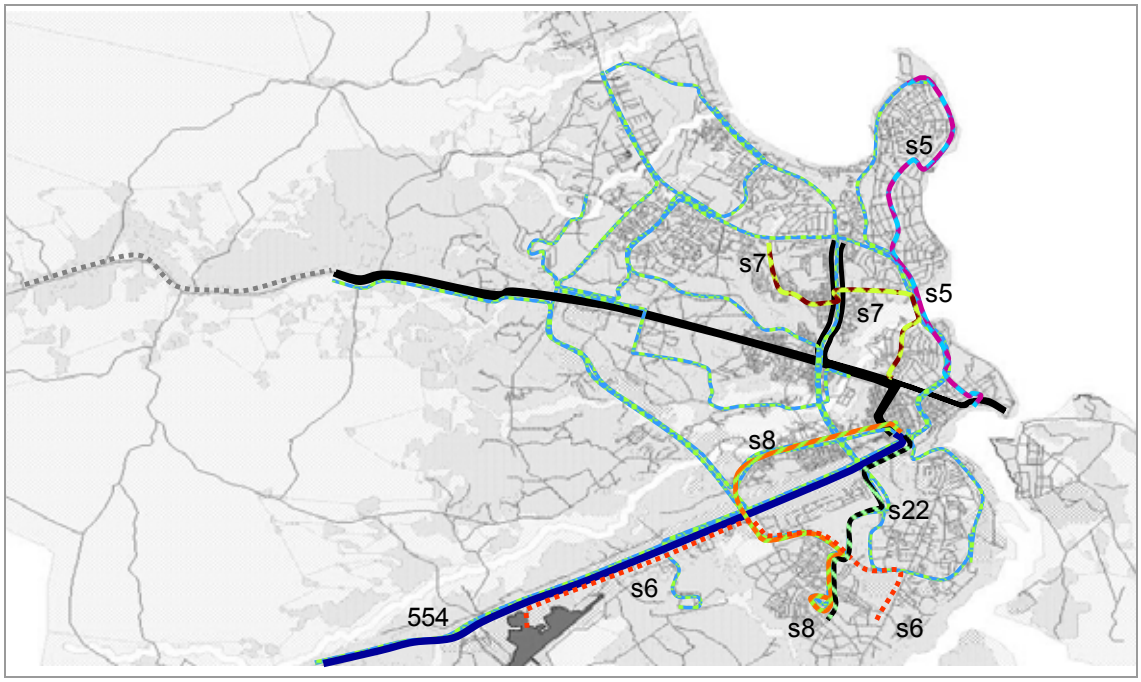



**Figure 11.6.2 Phase 2 Additional BRT and secondary routes**

### 11.6.3 Phase 3A Kilwa Rd and 3B Tabata Rail Corridor/ Mbgala Rd Link

Phase 3 is a major construction phase as it builds the Kilwa Rd BRT and includes the Gerezani redevelopment connecting the southern Kilwa Rd corridor direct to the CBD. The Gerezani options include the widening of Bandari Rd to include BRT or alternatively the building of an elevated road across the Port area for BRT only to directly connect the CBD. These options are fully discussed in *Chapter 5*. The Ubungo-Tabata line includes the redevelopment of the Railway St Station and building a busway along the disused portion of the Tabata rail corridor. The final portion of Phase 3B is the construction of a BRT busway along Mbagala Rd and a short section to Tandika. This completes the connection between Nyerere Rd and Kilwa Rd Mtoni. These phases are combined because they can be constructed more or less simultaneously and includes the Mbagala link with the Tabata corridor development because it synchronizes the route development making implementation of bus service changes smoother and more coherent.

**Phase 3A Corridor Description**

*Phase 3A* is the implementation of BRT from Mbagala along Kilwa Rd. There is a major issue in connecting this corridor the CBD and the Kariakoo Interchange, and options are discussed in a priority area discussion being Gerezani Area Enhancement Plan Discussed in *Chapter 5*.

**Phase 3A Construction Issues**

The reconstruction of Kilwa Rd is due for completion in March 2009. This will have developed Kilwa Rd to a 4-lane road with reserves for a median BRT. Assuming a 12 -18 month construction period to establish BRT, implementation for a BRT could be estimated as early as 2010, however it is programmed under this plan to be a 2012 introduction, mainly due to the need to construct the Gerezani section to connect the BRT to the CBD and Kariakoo and the construction of the Railway St station as a BRT terminus.

**Phase 3A Route Operation**

Under the Phase 3A introduction 3 routes will operate to the CBD, as shown **Table 11.6.4.** Some of these longer routes could operate as a limited stop express to improve efficiency (e.g. the 884 from Kongowe could operate as a non-stop between Mtoni and the CBD with passengers for intermediate stop transferring to the all-stops service at Mtoni).

**Table 11.6.4 Phase 3A Routes**

| Phase 3A | Kilwa Rd | | km |
|---|---|---|---|
| New | 881 | Mtoni to Kariakoo via Kilwa Rd | 11.0 |
| New | 882 | Mbgala to Kivukoni via Kilwa Rd | 16.0 |
| New | 884 | Kongowe to CBD via Kilwa Rd | 18.0 |

**Phase 3B Corridor Description**

The first part of *Phase 3B* involves the construction of BRT along the Ubungo-Tabata rail corridor and this could be done concurrently to Phase 3A. This disused rail link travels south from Ubungo to Buguruni on the eastside of Nelson Mandela Rd then crossing Mandela Rd to Buguruni where it crosses Mandela Rd eastwards to Kariakoo crossing Nyerere Rd (via BRT flyover) and follows the rail corridor to the Railway St Station (reconstructed as a BRT terminus) at Sokoine Rd.

While this link creates an essential public transport access to these western suburbs, the main advantage of this scenario is that it diverts an alternatively proposed future BRT from Nelson Mandela Rd to this disused rail corridor. Considering the heavy seaport freight traffic travelling along Nelson Mandela Rd, this is a highly preferable option and is therefore recommended by the Study Team.

The second part of Phase 3B is the construction of the busway along Mbagala Rd connecting the Tabata rail line across Nyerere Rd to Kilwa Rd.

**Phase 3B Construction Issues**

For *Phase 3B*, availability of this rail corridor is subject to negotiation with TRL which makes the implementation dates uncertain. But with some political will to improve the public transport for this area, it may be possible to expect a resolution during 2008- 2009. If this occurred it would allow a relatively early introduction, but the implementation plan has this extension scheduled for 2012 at the earliest.

The Phase 3 completion will require the reconstruction of the Railway St station as a BRT terminus and the BRT directional flows for this area (servicing both the Kilwa Rd and the Tabata lines) and is shown in **Figure 11.6.8.**

Furthermore, this BRT line will not enter the Kariakoo interchange but requires the building of a BRT station on the south side of the Kariakoo Interchange with pedestrian access to the interchange.

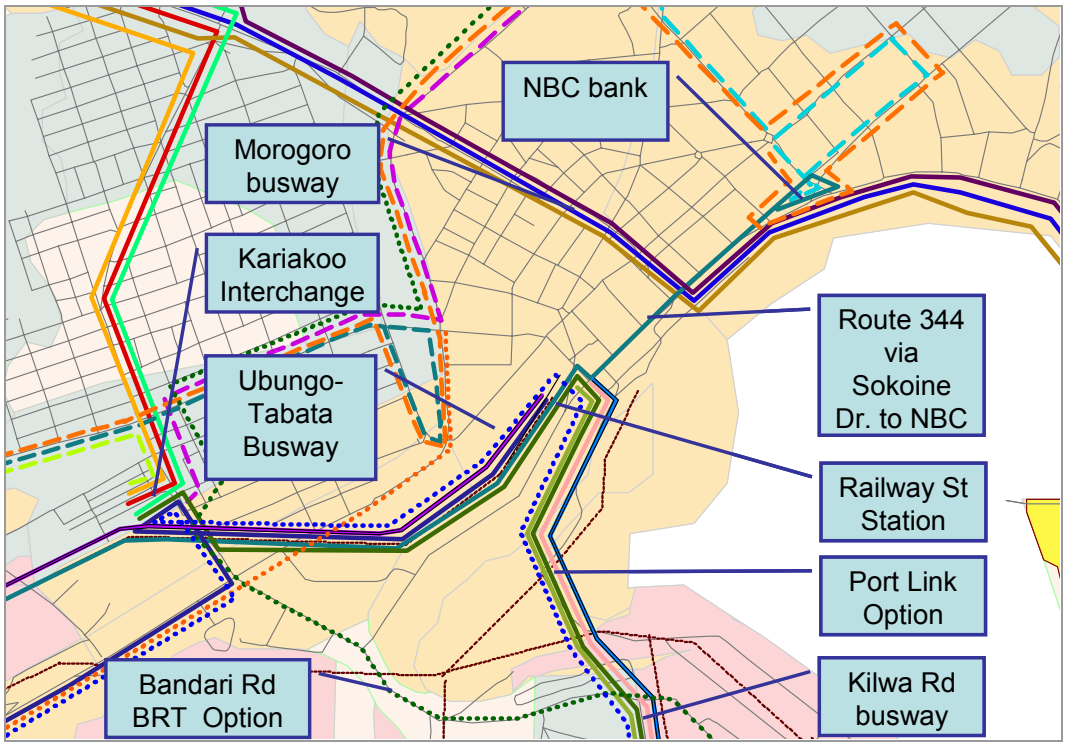



**Figure 11.6.8 Bus route layout Railway St Station precinct**

**Phase 3B Route Operation**

The new *Phase 3B* routes are shown as **Figure 11.6.9** and listed in **Table 11.6.5**

Route 144 is the main service from Ubungo (interchange with Morogoro Rd services) to Kariakoo (BRT station on south side of interchange) and then travelling to the CBD (interchange with Kilwa Rd service). While this route appears to be a duplicate Route 554 along Nyerere Rd for a section, this is not the case, as the rail line separates access from Nyerere Rd.

Route 248 replaces secondary route S20 travelling via the Morogoro Rd busway to the Tabata busway and the Mbagala Rd busway to Tandika. This becomes an important cross suburb connection supporting a high travel demand. Two major BRT intersection transfer points are offered being Nyerere Rd, Tabata Line at Buguruni and the Ubungo terminus.

Route 500 replaces secondary route S6 redirecting buses from Nelson Mandela Rd to the Mbagala BRT link travelling to Tandika. An additional secondary route (S85) will be implemented as a 2-way loop service operating along Mandela Rd , Nyerere Rd, Kilwa Rd, and Temeke. Alternatively this route can operate as a BRT complementary bus using Mbagala Rd, Nyerere Rd Tabata line and Kilwa Rd using the busways for the entire loop.

**Table11.6.5 Phase 3B Routes**

| Phase 3B | Ubungo -Tabata Rail Corridor & Mbagala Rd Tandika Link | | km |
|---|---|---|---|
| New | 500 | Airport - Mtoni via Nyerere Rd & Mbagala Rd | 12.5 |
| New | 144 | Ubungo - Tabata to CBD (Rail Corridor) | 13.2 |
| New | 248 | Kimara to Tandika via Tabata line | 19.0 |
| Remove | S6 | Replaced by 500 | |
| Remove | s20 | Replaced by 284 | |
| New | S85 | Mandela Rd (ot Mbagala Rd), Nyerere Rd, Kilwa Rd, Temeke Loop | 16.5 |

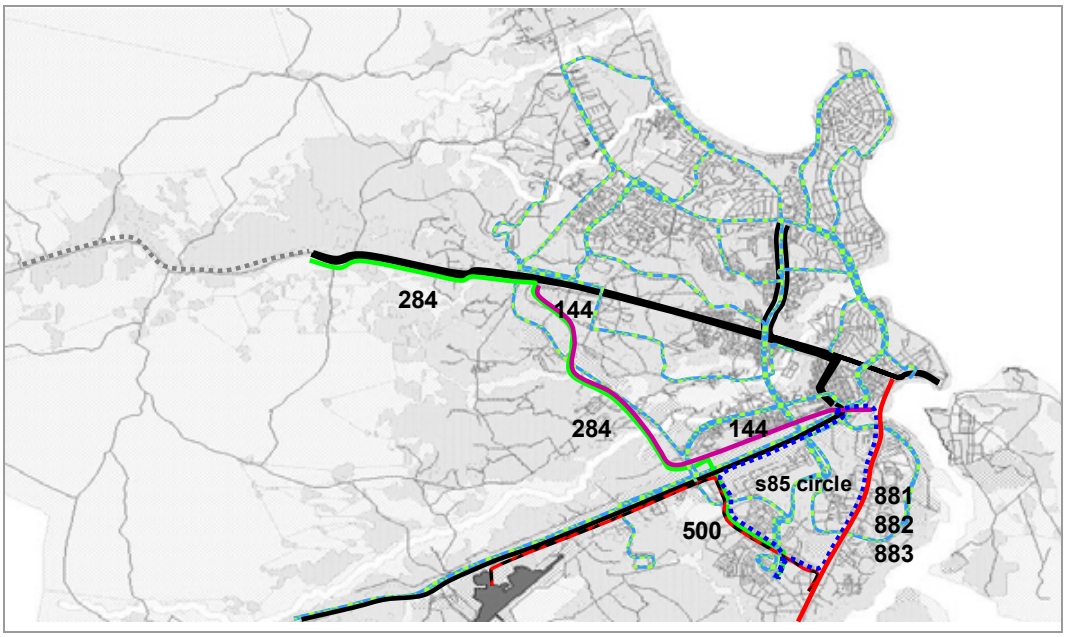



**Figure 11.6.9 Phase 3A & 3B routes**

## 11.6.4 Phase 4A Sam Nujome and 4B Bagamoyo Rd to Makongo

Phase 4 includes a major north western BRT initiative covering Sam Nujome Rd and Bagamoyo Rd.

**Phase 4 Corridor Description**

*Phase 4A* is the Sam Nujome Rd section extending the BRT from Ubungo to Mwenge.

***Phase 4B*** comprises the extension of BRT from Morocco terminal to Mwenge and through to Makongo /Kawe.

**Phase 4 Construction Issues**

For *Phase 4A*, Sam Nujome Rd is presently under reconstruction to a 4-lane road with reserves for a median BRT. Assuming a construction being completed in late 2008 and a 12-18 month construction period for a BRT, implementation could not occur before 2010, but the implementation plan has this section scheduled for 2013 at the earliest.

*Phase 4B* comprises the extension of BRT from Morocco terminal to Mwenge and through to Makongo /Kawe.

**Phase 4 Construction Issues**

The section of Bagamoyo Rd between the proposed Morocco BRT terminal and the Makongo /Kawe area is planned for a reconstruction to a 4 lane road with a median BRT reserve (as at 2007 an 'almost committed' status). This construction is planned to commence in 2011 and take 12 months to complete. Assuming that a BRT construction occurs during 2012, a BRT could be implemented in 2013. It would be possible (and possibly less expensive) to do a concurrent BRT construction while road widening is underway which will allow an earlier introduction.

**Phase 4 Route Operation**

The new routes and route modifications for Phase 4 are shown in **Figure 11.6.10** and listed in **Table 11.6.6**.

**Table 11.6.6 Phase 4 Routes**

| Phase 4 | Sam Nujome, Bagamoyo Rd Section and Kawawa Link | | km |
|---|---|---|---|
| Extend 111 to Mwenge | 311 | Mwenge to Kariakoo via Sam Nujome & Ubungo | 13.4 |
| Extend to Mwenge | 332 Ext | Mwenge to Kivukoni via Bagamoyo Rd & Morocco | 13.0 |
| Extension to Makongo | 344 | Makongo - Mwenge - Ubungo - Tabata to CBD (Tabata Rail Corridor) | 20.0 |
| | S3 | Replaced by S3 - M and BRT route 344 extension | |
| Shorten | S3-M | Ubungo to CBD via Mandela Rd - Uhuru Rd, Bugurundi | 14.7 |
| New | S13 | Boko to Makongo | 21.3 |

Servicing *Phase 4* will require the extension of both the routes (111 & 114) from their previous termination at Ubungo through to Mwenge along the Sam Nujome BRT changing the route number from Route 311 and 344 respectively.

Similarly Route 332 previously terminating at Morocco will extend to Mwenge as Route 332 extension. The secondary route S3 is shortened to operate only from Ubungo to Kariakoo providing a lower frequency of service along Mandela Rd and Uhuru Rd becoming Route S3-m.

It is recommended that the S1 and S2 routes operate as BRT complementary buses as they both operate for a section of busway to allow better service integration.

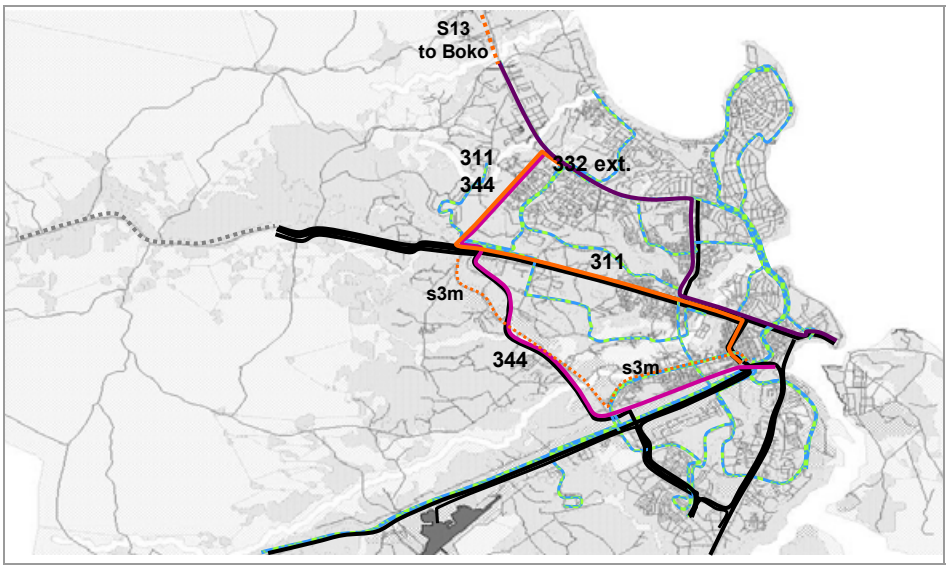



**Figure 11.6.10 Phase 4 Routes**

## 11.6.5 Phase 5 Kigamboni Extension

**Phase 5 Corridor Description**

The construction over a bridge over the Port channel at Kurasini from Nelson Mandela Rd will enable a Phase 5 BRT extension to link the Kigamboni area. In order to optimize the capacity of the bridge it should be constructed with a public transport priority and include 2 BRT lanes as well as a dedicated Cycleway and pedestrian pathway.

**Phase 5 Construction Issues**

The timeframe for bridge construction is uncertain, so this extension is placed last on the order of implementation. It is estimated at Yr. 2017

**Phase 5 Route Operation**

The operation of routes from the Kigamboni area is likely to require two routes; one to travel from the southern peninsula region beach area over the bridge to Kariakoo via Kilwa Rd and the other from the Kigamboni area travelling south and west to the bridge and joining the BRT at Kilwa Rd.

Two secondary route (S15- S16) will operate on the peninsula providing cross area services and connecting to the BRT as shown in **Figure 11.6.11.** and listed in **Table 11.6.7**

**Table 11.6.7 Phase 5 Routes**

| Phase 6 | Bridge to Kigamboni (full 2015-2020 network) | | km |
|---|---|---|---|
| New | 991 | South Kigamboni to Kariakoo | 14.5 |
| New | 994 | Kigamboni to CBD | 18.6 |
| New | S15 | Southern coastal route to Kigamboni | 25.0 |
| New | S16 | Southern inland route | 14.6 |

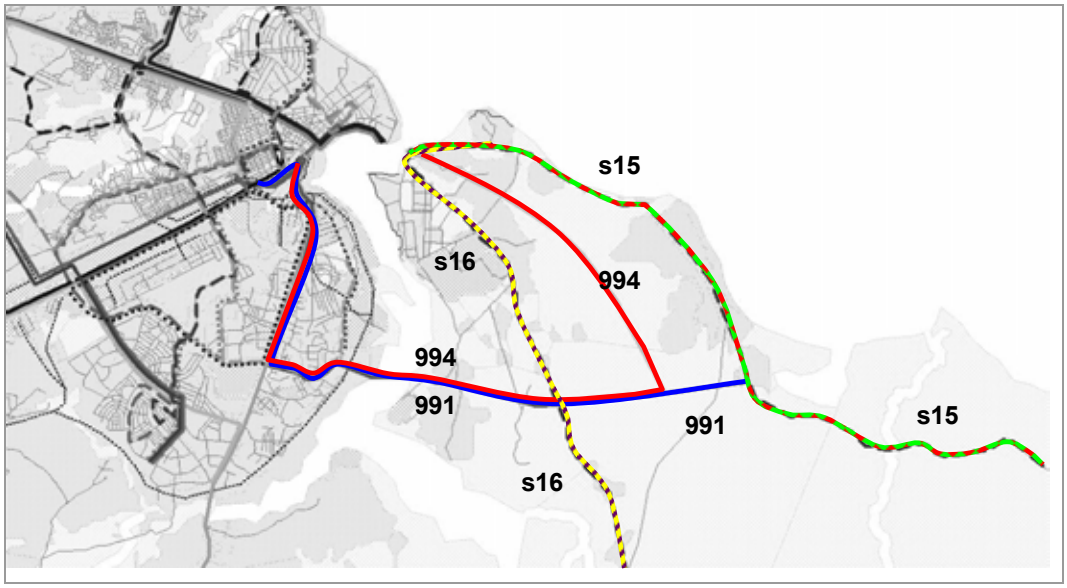



**Figure 11.6.11 Phase 5 Extension to Kigamboni**

## 11.6.6 2030 Full Network

While there is uncertainty in planning much detail for a 20 year time frame, this final stage assumes the development of the 2030 Road plan with the development of additional trunk roads from the Kigamboni peninsula towards the western suburbs. The plan also includes the Boko (via Tegeta) BRT extension although this could be brought forward at any point when demand is sufficient. This Boko BRT section would replace secondary bus route S13 which would be diverted via the coastal road to Bunji.

The indicative routes for the Yr 2030 plan are shown in **Table 11.6.8** with the previous **Figure 11.5.12** showing the indicative route layout.

**Table 11.6.8 2030 Full Network Routes**

| 2030 | Full network | | km |
|---|---|---|---|
| New | 600 | Kigamboni to Ubungo via Vijibweni Bridge and Tabata | 30.0 |
| New | 644 | Southern extension to CBD via Tazara and Buguruni | 33.4 |
| New | 684 | Southern extension to CBD via Kilwa Rd | 26.4 |
| New | 333 | Northern Boko extension | 18.2 |
| Diverted to coast with intro of 333 | S13-m | Northern Route via Bunji | 17.9 |

### 11.6.7 Coordination of Phase 1 Secondary routes with Phase 1 DART Proposal

The secondary bus route plan is a diversion from the present feeder route planning of the DART BRT Phase 1 plan as the latter was specifically aimed at 'feeders to the BRT' as with less emphasis n cross city coverage.

This section compares the two plans to evaluate how they can be synchronized in implementation but specifically takes the approach of determining which secondary routes can be implemented as BRT feeders in the inaugural stage of BRT Phase 1

**Table 11.6.9** lists the secondary routes and details the recommended action to coordinate the planning of DART Phase 1 BRT with the secondary routes of the Master Plan.

For the purposes of easy comparison, the DART Phase 1 Feeder Routes are shown as **Figure 11.6.12** with Phase 1 and 2 secondary route plans shown as **Figures 11.6.13** and **11.6.14** respectively.

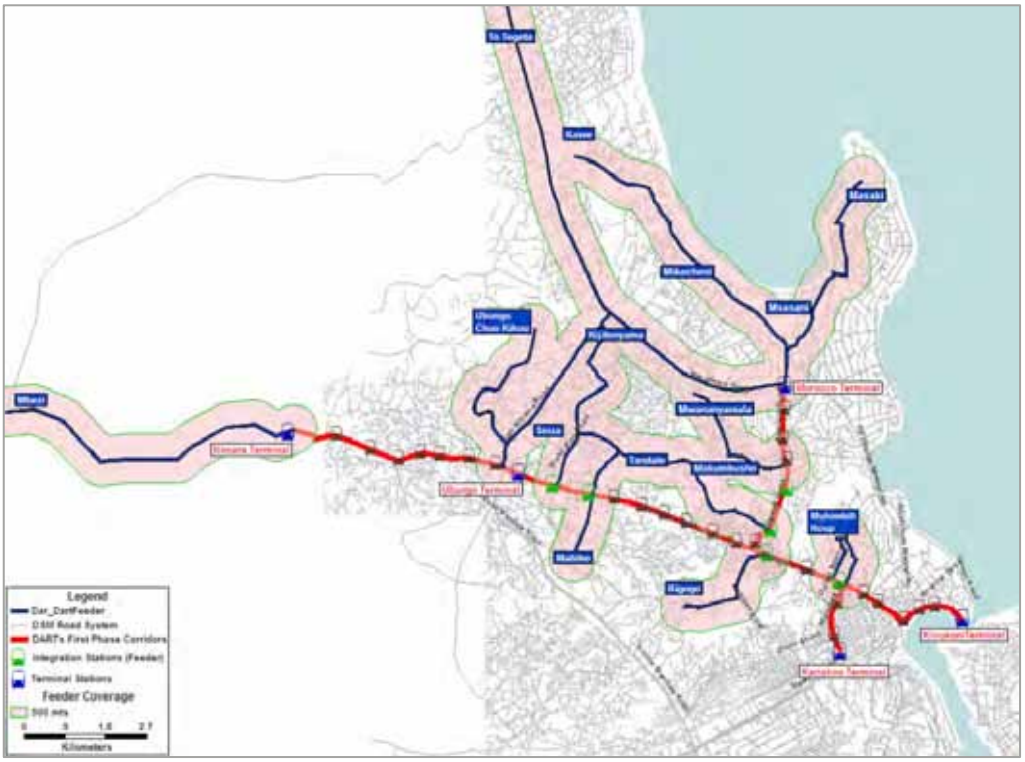



**Figure 11.6.12 DART Phase 1 Feeder Routes**

**Table 11.6.9 Secondary Bus Routes**

| DART Phase 1 Feeder route | Recommendations and actions |
|---|---|
| FR 002 Morocco - Masaki | Recommendation: Operate the FR002 at the Phase 1 implementation. At a future phase the S21 can interchange at Morocco terminal and then continue southbound along Ali Hassan Mwinyi (this is best coordinated with Phase 4 when the S21 can interchange on Bagamoyo Rd). |
| FR 003 Morocco – Msasani / Mikocheni<br>FR 004 Morocco to Kawe via Mikocheni | In the short term, operate the FR 003 and FR 004 with a later extension of these feeders as a complementary bus (the S1) along the Morocco section of the BRT and then southbound via Kawawe Rd South to Tandika. |
| FR 005 Morocco – Mwenge via Bagamoyo Rd<br>FR 006 Morocco to Tegeta Village | Implementation of the FR005 feeder bus from Mwenge to Morocco can be completed in the first phase with a later transition to a full S2 service to continue on to the CBD. When the FR005 operates it will be evident the number of commuters needing to travel via Ali Hassan Mwinyi to the CBD indicating the level of services that need to be installed as the completion of the S2 service.<br>The FR 006 is a similar service to the S13 service to Boko. |
| FR 007 Kimara- Mbezi | This is the same as the S14 secondary bus |
| FR 009 Ubungo – Mwenge | The FR 009 is the northern section of the S3 secondary bus and can be introduced as a first phase S3 with the southern extension to Buguruni added at a later stage. |
| FR 010 Ubungo - University<br>FR011 Shemwe / Shekilango Rd<br>FR 012 Shekilango station to Sinza and Manzese Wards | S12 Secondary route replaces FR10 FR011&FR012 and connects northward to the Mikocheni area. It is recommended to implement S12 to cover these areas, with a short leg S12 operating in peak hours (similar to the FR 012). The S12 is an ideal complementary bus in that it can interchange at Shekilango and Ubungo stations thus avoiding large interchange facilities and uses the busway to join the Shekilango Rd and Sam Nujome Rd. |
| FR013 Sinza and Manzese Wards via Tandale Rd to Magomeni (Kinondoni Station) | The S9 secondary bus covers the Tandale Rd section to Magomeni and it is recommended to introduce the FR 013 service as the first stage of a S9 service that can be extended to the Port during a later phase. |
| FR014 Mwananyamala and Kijitonyama to Kanisani Station | This route is part of the future S7 route and can be introduced as a FR014 feeder and extended as a \S& route during a later phase. |
| FR015 Mabibo area to Urafiki Mahakama station FR 016 Kawawe Rd South to Kigogo Ward | The FR 015 and the FR 016 form parts of the S11 secondary bus. The S11 service should be introduced as a complementary bus connecting the Mabibo area to the Urafiki Mahakama station and the Magomeni Mapipa Station. A complementary bus reduces the needs for large interchanges at these two stations, and the U-shaped link between these two stations (operating as one route only) is more fleet efficient as the return leg for one station is the forward leg for the other. |
| FR 017 Hospital to Fire Station Loop service | This small feeder service can operate as planned. In future it may be replaced by the S7 complementary bus. |

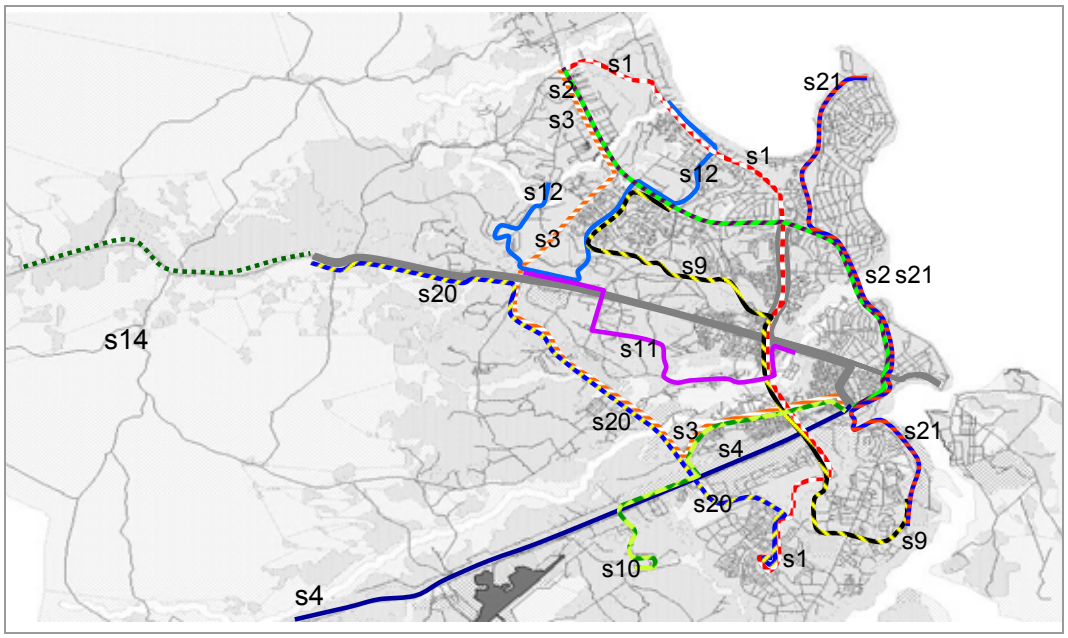



**Figure 11.6.13 Phase 1 Route Plan – Master Plan**

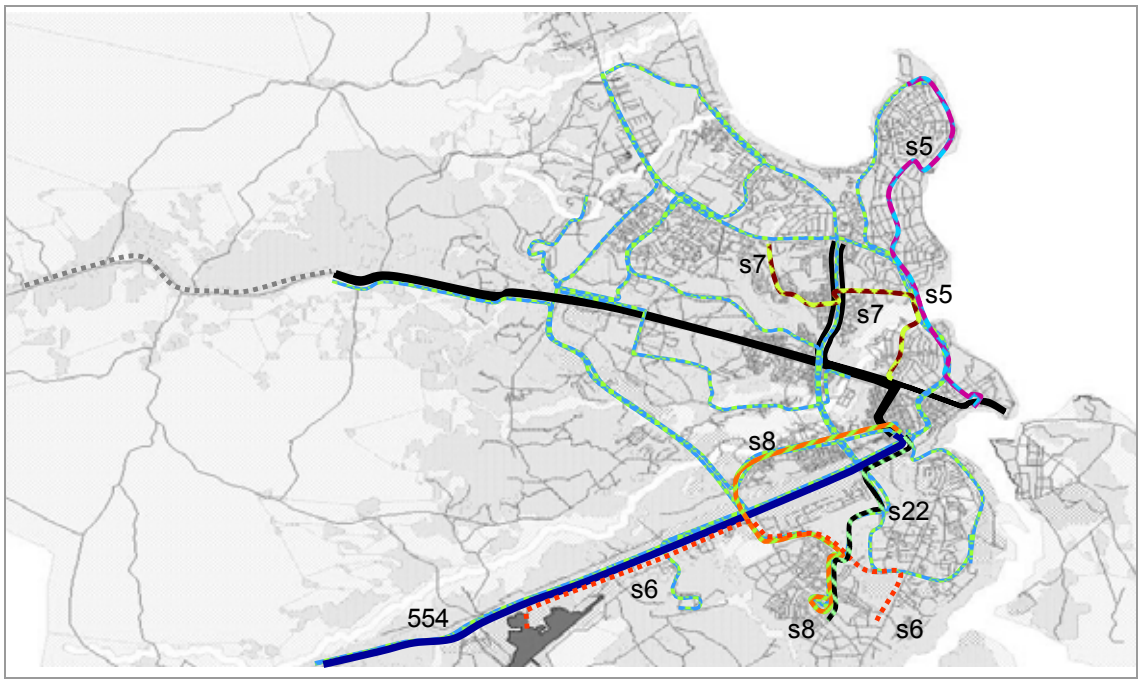



**Figure 11.6.14 Phase 2 Route Plan – Master Plan**

# Chapter 12 Validation of BRT Route Design with Existing Travel Demand

## 12.1 Demand Surveys

Extensive survey work on passenger demand produced considerable data on existing travel patterns and volumes of public transport trips at intersections and along corridors. This data was transposed logically across the network bus assigning passenger demand per sector which was used to develop the route patterns initially (establishing routes that required direct services) and then used to scale demand and assign bus frequencies to those sector.

## 12.2 Modelling Passenger Demand

**Table 12.2.1** shows the calculations of bus allocations per route based on surveyed sector demand which provides source data for the Bus Operations Model.

The model is capable of modelling the bus capacity required (passengers per hour/ per direction) on a sector by sector basis (using the surveyed demand data by corridor) and assists to plan an efficient network, ensuring sufficient bus capacity is provided on each route sector and also that under capacity is reduced.

An industry benchmark for capacity estimates total passengers at 80% of capacity, and the model drew an average result of 82% which is above the acceptable level. This indicates some level of confidence is possible for the model outcomes, firstly the assurance that sufficient bus capacity is provided, and secondly that the cost and revenue estimates are related to the surveyed passenger demand and lastly that the bus service frequency is optimized to demand.

## Table 12.2.1 Passenger demand modelling by sector

| Bus allocation | | |
|---|---|---|
| Route | Allocated Buses per hour | |
| Phase 1 | Peak | Off Peak |
| 212 | 20 | 12 |
| 211X | 15 | 9 |
| 111 | 15 | 9 |
| 112X | 40 | 24 |
| S1 | 50 | 30 |
| S2 | 90 | 54 |
| S3 | 60 | 36 |
| S4 | 90 | 54 |
| S9 | 20 | 12 |
| S11 | 20 | 12 |
| S12 | 20 | 12 |
| S14 | 60 | 36 |
| S20 | 60 | 36 |
| S21 | 20 | 12 |
| 332 | 12 | 8 |
| 331 | 12 | 8 |
| S10 | 30 | 18 |

| BRT routes Passenger Demand Peak Hour by Corridor/Sector | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Corridor by sector | Sector No. | Surveyed demand p.h | Calcs & adds | Routes along sector | Total buse/hr | Routes along sector | Total buse/hr | Total BRT Fleet capacity/ sector | Total Sec. fleet capacity /sector | Capacity meets demand (full capacity =100%) |
| Phase 1A & 1B | | | 10% | BRT | | Secondary | | BRT | Secondary | |
| Boku section | 3a | | | | | | | | | |
| Makonga Section | 3b | 4220 | 4642 | | | s2-s3 | 150 | | 9,000 | 52% |
| Mwenge Section | 3c | 4720 | 5192 | | | s2 | 90 | | 5,400 | 96% |
| Mikocheni Section | 3d | 2540 | 2794 | | | s1 | 50 | | 3,000 | 93% |
| Morocco Section Kawawa Rd | 3e | 3830 | 4213 | 331-332 | 24 | s1 | 50 | 3600 | 3,000 | 64% |
| Msasani area | 7a1 | 1080 | 1188 | | | s21 | 20 | | 1,200 | 99% |
| Msasani Peninsula | 7a2 | 1000 | 1100 | | | | | | | |
| Selander Bridge | 7b | 3580 | 3938 | | | s2, s21. | 110 | | 6,600 | 60% |
| United Nations road | 7d | 880 | 968 | | | | | | | |
| Mbezi | 2a | 3600 | 3960 | | | s14 | 60 | | 3,600 | 110% |
| Kimara | 2b | 7253 | 7978 | 212/-211x | 35 | S20 | 60 | 5250 | 3,600 | 90% |
| Ubungo- Shekilango | 2c | 8200 | 9020 | ,212-211x-111-112x | 90 | | | 13500 | | 67% |
| Magomeni Mapipa - Fire Station | 2d | 6880 | 7568 | 212-211x-111-112x 331-332 | 114 | | | 17100 | | 44% |
| East of Magomeni | 2e | 9580 | 10538 | 212-112x 332 | 72 | | | 10800 | | 98% |
| Sam Nujome | 4a | 3040 | 3344 | | | s3 | 60 | | 3,600 | 93% |
| Mandela / Tabata Corridor | 4b | 3600 | 3960 | | | s20 - s3 | 120 | | 7,200 | 55% |
| Uhuru Rd Bugurundi (Split s4 344) | 4c | 2000 | 2200 | | | s3 -s10 | 90 | | 5,400 | 41% |
| Bugurundi Rail corridor | 4d | 2000 | 2200 | | | | | | | |
| G/Mboti | 5a | 4500 | 4950 | | | s4 | 90 | | 5,400 | 92% |
| Nyerere Rd Airport- Tazara | 5b | 6830 | 7513 | | | s4-s10 | 120 | | 7,200 | 104% |
| Mandela Sth-Mbgala Rd | 5c | 3500 | 3850 | | | s20 | 60 | | 3,600 | 107% |
| Nyerere Rd - Tazara- CBD | 5d | 4120 | 4532 | | | s4 | 90 | | 5,400 | 84% |
| Kawawe Rd South | 6a | 4000 | 4400 | | | s1-s9 | 70 | | 4,200 | 105% |
| Changonmbe Rd | 6d | 2700 | 2970 | | | s1-s9, | 70 | | 4,200 | 71% |
| Bandari to Port | 8d | 1060 | 1166 | | | s21 | 20 | | 1,200 | 97% |
| | | | | | | | | | Average capacity loading | 82% |

# Chapter 13 Bus Network Operational Plan

## 13.1 Preparation and Process

The process of developing the operational model based on the route development plan is demonstrated in the flowchart of **Figure 13.1.1**

The operational modeling relies on the inputs of the developed network plan (No. routes and km), ridership data and fare levels and fleet data (vehicles and operating costs) to calculate operational scenarios.

The purpose of such forecasting is to estimate physical requirements and operational costs to inform the implementation process. While the estimated road development and construction timetable has been used as an input to planning, more detailed forecasts can also inform the development and implementation timetable of BRT and associated infrastructure projects.

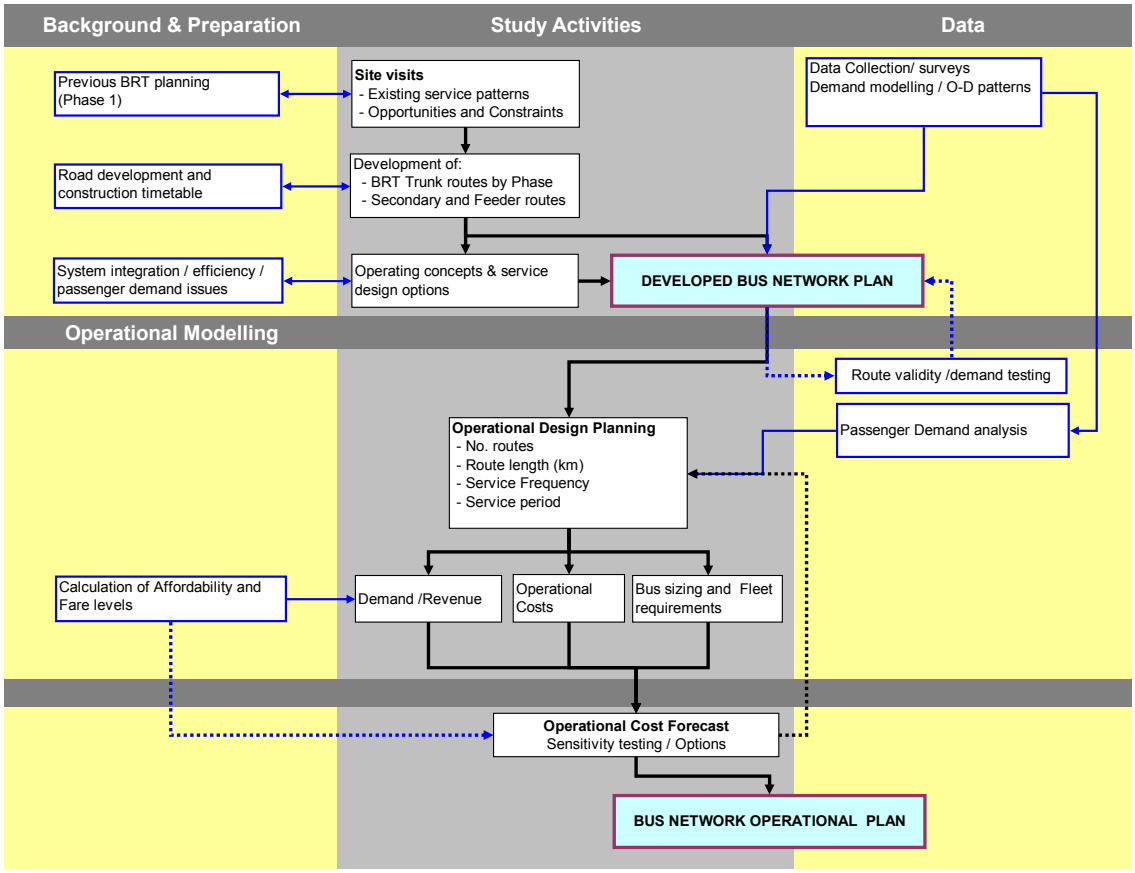



**Figure 13.1.1 Work processes and outputs of operational planning**

## 13.2 The Bus Operations Forecasting Model

A Bus Operations Planning Model can provide an operational forecast and the basis for conducting sensitivity tests on costs and specifically fare levels. Operational costs are benchmarked on known values, industry averages, and known costs.

The information input to the model includes:

- Route Design and kilometres;
- Program of implementation;
- Passenger demand / bus allocation per hour for Peak/Off Peak;
- Fleet type over types of service;
- Capital expenditure and financing costs and depreciation period;
- Assumptions on cost and consumption;
- Operating parameters (hours/days and peak and off-peak hours);
- Estimated average fare levels.

The outputs from the model calculations include:

- Total passengers (Peak. vs. Off-peak by week month or year);
- Kilometres of operation;
- Number of buses required by type;
- Financial outcomes for the operating period (EBIT).

Trip data calculations calculate the total fleet capacity, bus operating km and passenger numbers for peak hours, off peak hours (M-F) and Sundays. Salary and wages estimates are based on the volume of services (staffing numbers) and the number of depots, the staffing numbers are then calculated and staffing salary levels applied. Based on all the data and calculations of the previous tables, an estimate of the annual profit and loss estimate is calculated (for Yr 1).

Sensitivity tests can be applied to test various cost/revenue scenarios and also variants to fare level, bus speed, bus capital costs and fuel costs.

Note: *The model calculates very large amounts of information to enable a forecaster to scope and test scenarios. Its accuracies are wholly reliant on realistic input data and benchmark cost. It should be treated as a planning tool only and not a prediction of future operation. Passenger transport demand and travel behaviour can be fluid and dynamic, especially when route network changes are effected. However, provided overall travel demand figures are realistic and some effort is made to benchmark costs to a reasonable accuracy, the model is an efficient planning tool.*

## 13.3 Model Results

### 13.3.1 Operational Statistics

**Table 13.2.1** shows the modelling results indicating the increase in bus fleet size per phase of introduction and the kilometres for BRT and secondary routes respectively. The last columns show the preliminary estimates of fleet acquisition required by phase/ year, indicating that some streamlining is possible where surplus buses appear in year 2011 and 2013.

**Table 13.2.1 Kilometres and Fleet (per phase)**

| Introduction | | Kilometres | | | Buses by fleet type | | | Fleet acquisition | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Phase | BRT Routes | Secondary Routes | Total | BRT | Sec | Total fleet | BRT | Sec |
| 2009 | 1A | 9,981,000 | 74,376,000 | 84,357,000 | 82 | 826 | 909 | 82 | 826 |
| 2009 | 1B | 11,824,200 | 76,725,000 | 88,549,200 | 96 | 853 | 949 | 14 | 26 |
| 2011 | 2 | 18,505,800 | 74,566,440 | 93,072,240 | 151 | 827 | 977 | 55 | -26 |
| 2013 | 3A | 24,896,160 | 78,033,420 | 102,929,580 | 204 | 865 | 1068 | 53 | 38 |
| 2013 | 3B | 29,379,060 | 69,708,420 | 99,087,480 | 238 | 773 | 1011 | 34 | -92 |
| 2015 | 4 | 34,939,260 | 73,074,420 | 108,013,680 | 285 | 810 | 1095 | 47 | 37 |
| 2017 | 5 | 39,040,380 | 81,209,880 | 120,250,260 | 333 | 899 | 1232 | 48 | 89 |

### 13.3.2 Model Inputs & Assumptions

The model is able to scope operating costs according to kilometres of operation and fleet size, and these estimates are based on the following operational assumptions:

- 18 hr /day operating (6 hrs peak/ 6 days)
- 50% of services off peak and Sunday
- 18 metre trunk buses with a bus capacity of 170 passengers
- 12 or 15 metre complementary/ secondary buses with 60 passenger capacity
- Industry benchmark costs (fuel, maintenance, salaries)
- Average operating speed
  - 27 kph for BRT
  - 20 kph for secondary buses

### 13.3.3 Fare Level Sensitivity

As a test case, the phase 1 BRT operation was modelled to understand the level of fare sensitivity and to test whether the level of quality is in fact affordable by the travelling public.

A number of operating scenarios were tried and based on the above operating assumptions it was found that an average fare of approximately **Tshs 390** was the 'break even' point after meeting all costs including management and ticketing. Note that this fare is not the 'base fare' comparative to the Tshs 250-300 daladala fare, but an average distance - based fare where there is no additional fare charged when passengers transfer buses. This level of fare is actually in line with the data and information

sourced through the Household Surveys conducted by the Study Team which indicated that most travellers spent approximately Tshs 400 for a journey.

Importantly, this result has included all costs of:

- Bus capital costs (for a US$ 300,000 articulated bus) amortized yearly;
- Cost of fares and ticketing (0.06% of revenue);
- System management costs for DART (7% of revenue);
- Bus operators margin over costs (@17%);

On the revenue side there was some advertising revenue added (on-bus and on-station).

Note that this result is indicative only and insufficient to determine detailed financial forecasts. However it is a good litmus test that demonstrates an acceptable result and a feasible operating framework.

### 13.3.4 Conclusion

The modelling also indicates that it is feasible to suggest that a fleet of **1232 buses** as a BRT / secondary network can carry the same number of passengers as the present daladala fleet carries plus the 4% annual increases up to the year 2017 (see previous **Table 13.2.1**)

This highlights the present operational inefficiencies of the daladala service explaining why passengers find the services expensive yet the operators have difficulty in surviving on the present fare levels. A major inefficiency is the non-scheduled nature of the present service where daladala have non-productive time waiting for passengers as they try not to depart termini without a full passenger load. The unplanned nature of services is in fact highly inefficient, in contrast to scheduled bus services where service densities are planned more closely to requirements (meaning more productive vehicles through less idle time and high average loading. If present daladala operated as efficiently as a scheduled service it would require only **3,250 buses** to carry the present passenger load (although some daladala operate as feeder services not included in the modelling).

Overall, it is clearly evident that there are large efficiency gains to be made under the new service plan and this is reflected in improvements to quality, financial viability and sustainability. This develops a good case for funding support, as any investment in this area will have large efficiency paybacks, both in economic terms and direct and indirect social and environmental benefits for the City and its citizens.

# Chapter 14 Implication on Present BRT Phase 1 Designs

The expanded network has a number of design features which will require some adaptation in the Phase 1 BRT design.

The factors in the network plan that have caused these impacts are:

- Increased use of secondary routes expanded network past the Phase I rendering major terminals redundant.
- Less daladala interchange stations (by using larger and fewer buses)
- Morocco terminus is redundant in the future

Under the secondary route network developed under the Master Plan daladala and small feeder buses in Phase 1 will be significantly reduced from the following areas :

- University & Shekilango (s12)
- From Sam Nujome & Mandela Rd (s3)
- From Mabibo, Mburahati, Kigogo (s11)
- From Mwananyama (s7) & Kinindoni Rd area and Upanga (s7)
- From Mikocheni, Msasani (s1 & s12)
- From Msasani Peninsula (s5)
- From Makonga, Mwenge, Changombe (s2)

The phase 1 BRT plan with a network of supporting secondary routes will have numerous interchange points where passengers can access the system, as indicated in **Figure 14.1.1**.

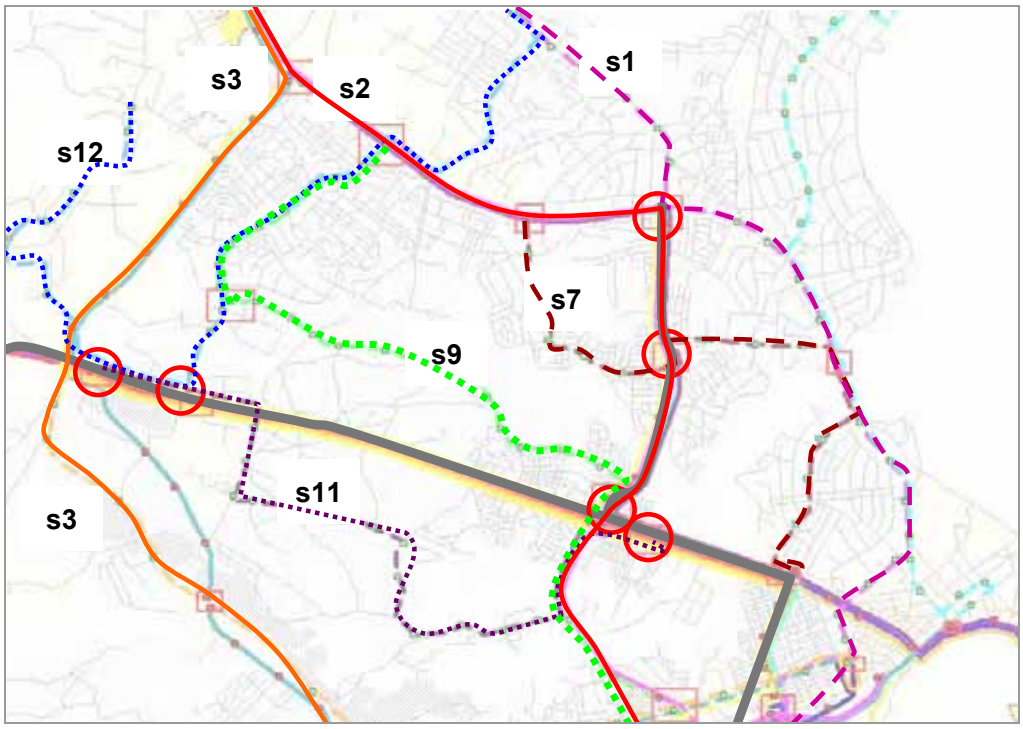



**Figure 14.1.1 Major Interchange Locations for Phase 1**

The operational and infrastructure implications of such a secondary route network is that less infrastructure needs to be built to manage high numbers of daladala at these interchange points. The present plans include daladala and bus interchanges at:

- Kimara
- Ubungo
- Shekilango
- Urafiki Mahakama
- Mlandezi St/Kawawa Rd
- Mangomeni Mapipa
- Morocco
- Fire station
- Kivukoni
- Kariakoo

**Figures 14.1.2** to **14.1.10** show some potential modifications where complementary buses can be used to reduce infrastructure requirements and also make the transfers smoother for passengers. It is expected to simplify the interchanges greatly as the pedestrian transfers are greatly reduced. The budget constraints may also be a pressing factor to reduce infrastructure in favour of using complementary services.

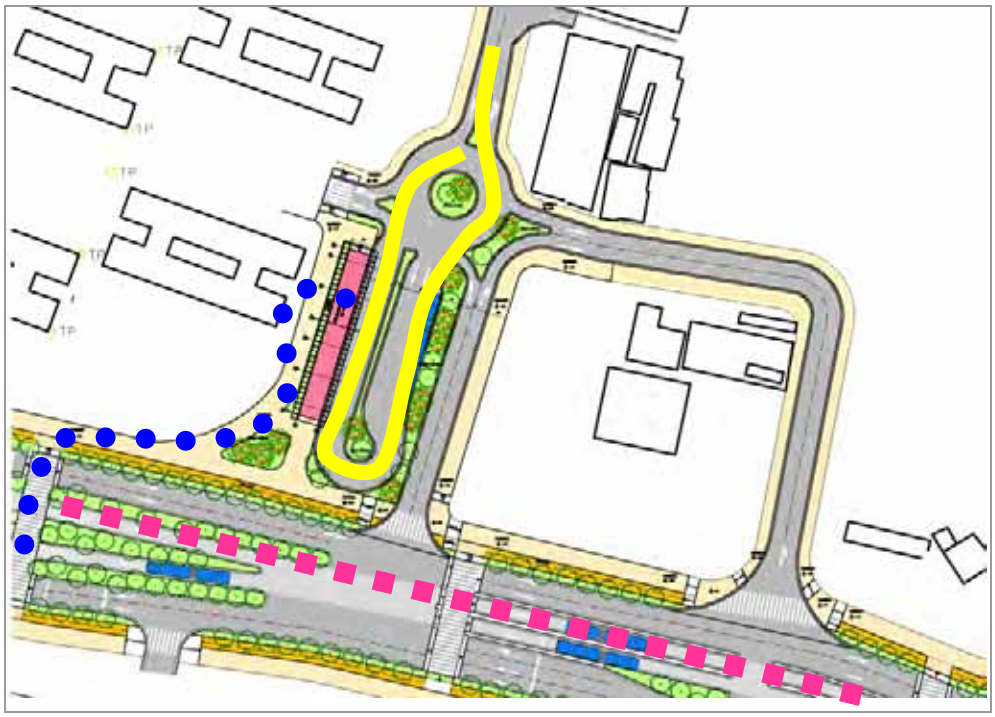


**Figure 14.1.2 Present Shekilango Planned Interchange**

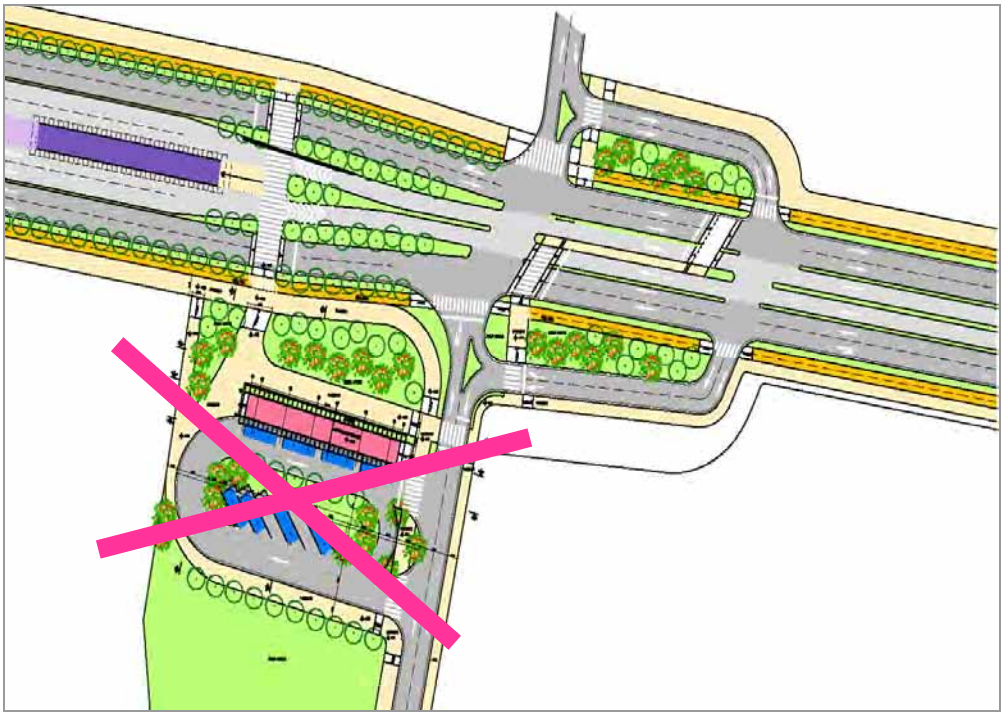


**Figure 14.1.3 Present Plan for Urafiki Mahakama Feeder Station**

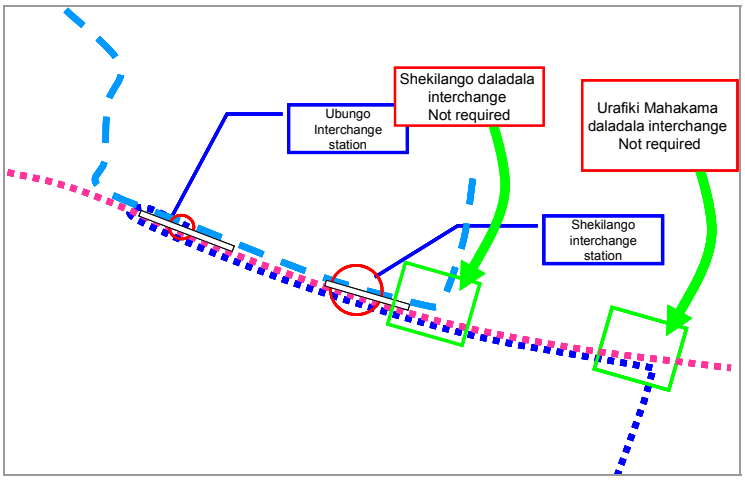



**Figure 14.1.4 Alternative Shekilango and Urafiki Mahakama scenario using complementary bus interchange at BRT stations**

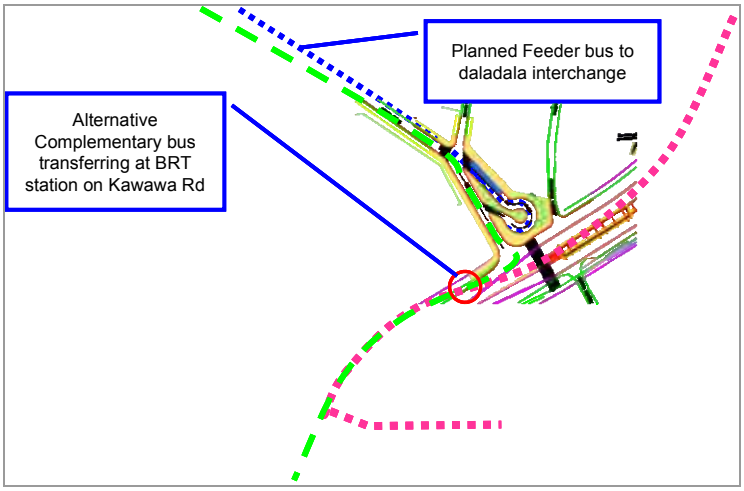



**Figure 14.1.5 Alternative complementary BRT interchange at intersection of Mlandizi St and Kawawa Rd**

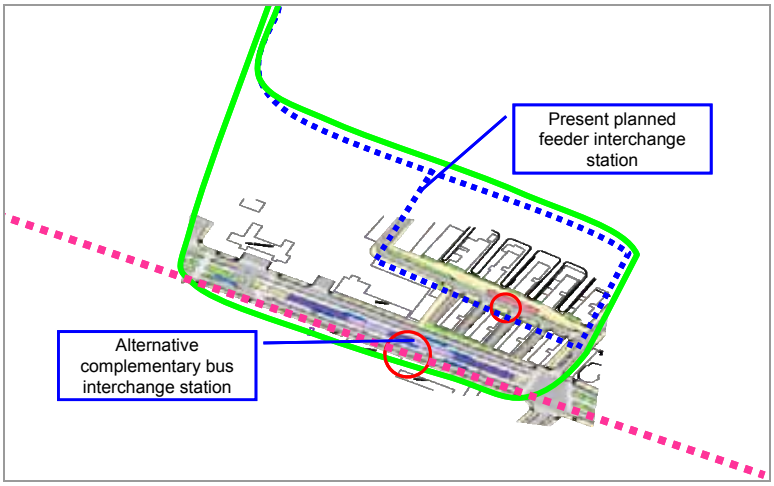



**Figure 14.1.6 Present plan for Fire station vs. alternative complementary bus interchange station**

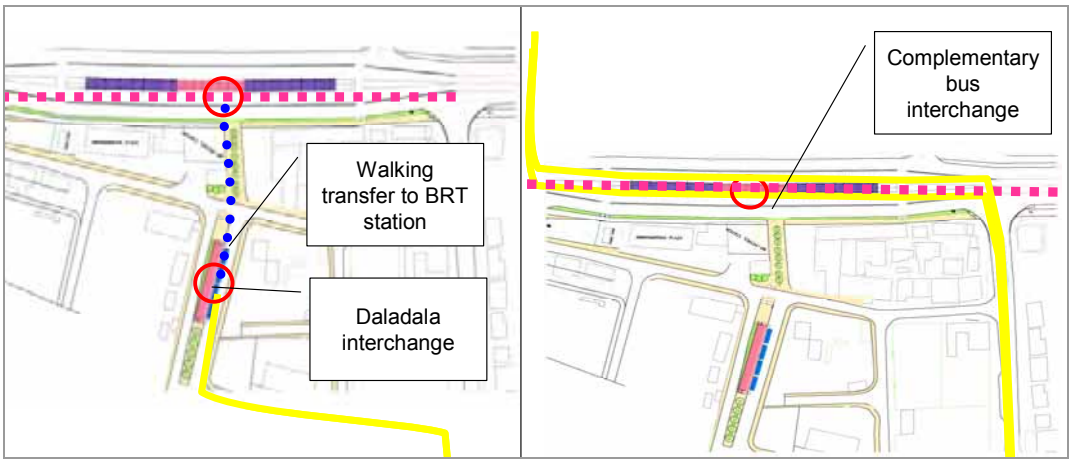



**Figure 14.1.7 Mwinijuma Present plan vs. complementary bus alternative**

**Figure 14.1.8 Kimara – can be simplified with a complementary bus interchange**

The planned terminus for Phase 1 is placed at Morocco with a relatively large construction to park and turn buses in the centre of the roadway. The station itself also featured extra passenger facilities as a terminus station. The future network however will not require any significant terminus at Morocco but instead requires a major terminus at Mwenge. Considering the major cost of building this facility it may be prudent to terminate the Phase 1 BRT at Dungo in front of the secondary school and turning the buses next to the presently planned Morocco terminus or in front of the school at Dungo. Future bus turnarounds can still use the turning area off-road as shown on the present plans.

The existing planned interchange/ terminus is shown as **Figure 14.1.9** showing the feeder bus circuit and the BRT trunk line.

The future station at the intersection of Kawawa Rd and Bagomoyo Rd could be placed at Bagamoyo Rd to improve future secondary bus interchange (See **Figure 14.1.10**).

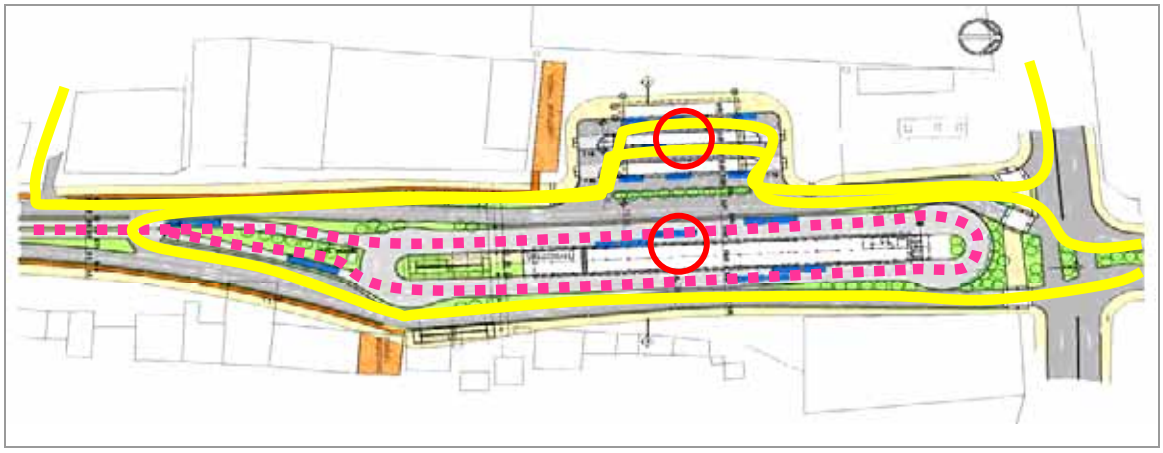


**Figure 14.1.9 Morocco terminus as planned showing feeder route movements**

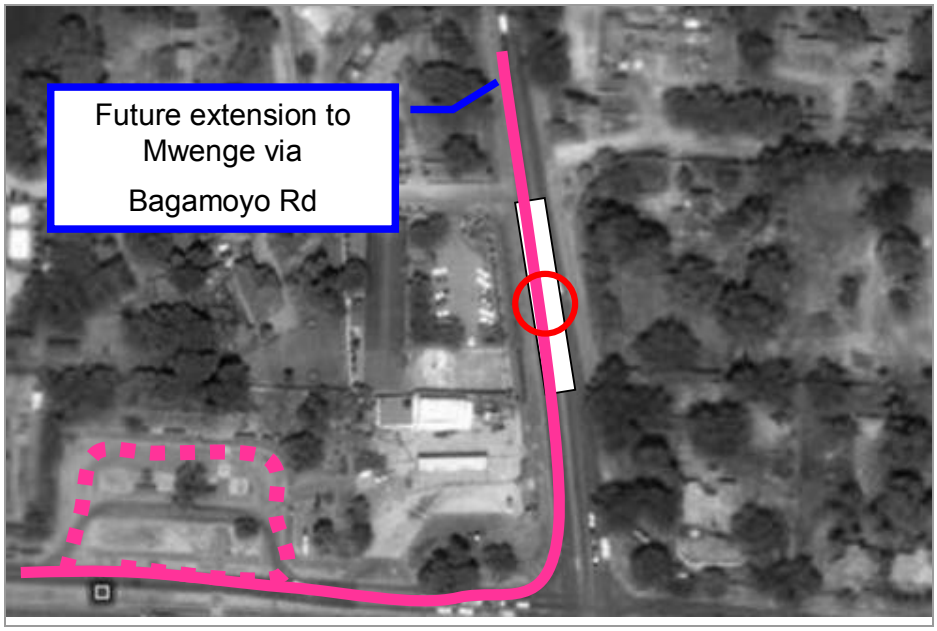



**Figure 14.1.10 Alternative Treatment of Morocco Terminus**

# Chapter 15 Implementation Issues for Public Transport Plan

## 15.1 Introduction

This section analyses the issues that confront the implementation of the Public Transport Plan.

Firstly and most importantly, Dar es Salaam has the advantage of having made significant planning progress toward the development of a BRT under the now established DART Agency. The Phase 1 plan for the DART BRT is a commendable plan that can deliver a high quality and sustainable transport system that will define the city's future. At the time of writing this report, the operational plan is completed and has informed the detailed design of infrastructure, and gives direction to the further planning of the 'software' components being operational contracts, business models and system control.

It is understood by the study team that the DART planning is not yet final and therefore it has taken some latitude to scrutinize some of the planning documents and raise areas of concern or risk exposure. Some assumptions have been made for the purposes of the operational plan which is standard practice and within DART's planning processes will be confirmed or varied. Comments made in this study are intended to be constructive and hopefully can assist DART in its efforts toward a successful implementation.

The whole Public Transport Plan is reliant on the successful delivery of a healthy DART organization. This is in fact the greatest challenge requiring sound planning to establish the technical skill and capacity to successfully manage the DART business. This section will include a list of implementation issues for the DAERT organization suggested actions for the DART Agency to complete its planning processes.

Secondly, the bus route planning under the DART phase 1 included all the BRT trunk routes with the support of feeder routes the BRT system. The *Chapter 10* outlines some integration issues in terms of the wider city planning and consequently a focus within the Master plan was to improve integration to develop a complete city wide network. Mainly this includes developing a secondary bus route concept (replacing some feeder routes) which will impact on operational design and infrastructure of the Phase 1 BRT design.

There is merit is revisiting some of these design issues (and may provide some considerable time and

cost savings) although it is stressed that the implementation of the Phase 1 should not be delayed on account of this.

Furthermore DART faces numerous implementation issues that can be very complex and this section discusses key risk areas to identify potential problem areas and develop sound management strategy.

## 15.2 Implementation Issues for DART

**Organizational development and capacity building**

DART Agency now established, but needs:

- Staffing and technical assistance;
- Capacity building as an agency (technical assistance);
- Establish the business model;
- Establish projects to manage detailed design work streams and implement specific components of the business;
- Refinement of service plan to align with wider Transport Master Plan.

**Physical infrastructure (hardware)**

- Finance approved;
- Build and oversight contracts to be arranged;
- Infrastructure design variations adjusted to suit wider Transport Master Plan.

**Contracts and systems and route operation (software)**

Specific detail design and implementation projects to establish system software:

- ITS bus control centre and traffic management (bus priority signaling);
- Fare collection and ticketing technology and management and business models;
- Appointment of fare Collector and fund manager under contract;
- Contracts and regulatory procedures for Bus operators (bus operators business model);
- Rationalization and consolidation of existing (affected) operators into bus operating entities;
- Specifications and assistance for fleet procurement/depot build and set up;
- Refinement of service plan & bus scheduling;
- Marketing and communications plan.

## 15.3 Revisiting Infrastructure Design Issues for Phase 1

The use of secondary bus routes and the use of BRT complementary routes that can link into the BRT

system for a 'bus -platform– bus' transfer render unnecessary a number of the large daladala interchanges.

Under the bus route plan, the small feeder buses in Phase 1 will be significantly reduced from the following areas with the Secondary routes numbers shown:

- University & Shekilango (s12);
- From Sam Nujome & Mandela Rd (s3);
- From Mabibo, Mburahati, Kigogo (s11);
- From Mwananyama (s7) & Kinindoni Rd area and Upanga (s7);
- From Mikocheni, Msasani (s1 & s12);
- From Msasani Peninsula (s5);
- From Makonga, Mwenge, Changombe (s2);

Complementary bus routes will interact with the system in Phase 1 at a number of points as shown in **Figure 15.1.1**.

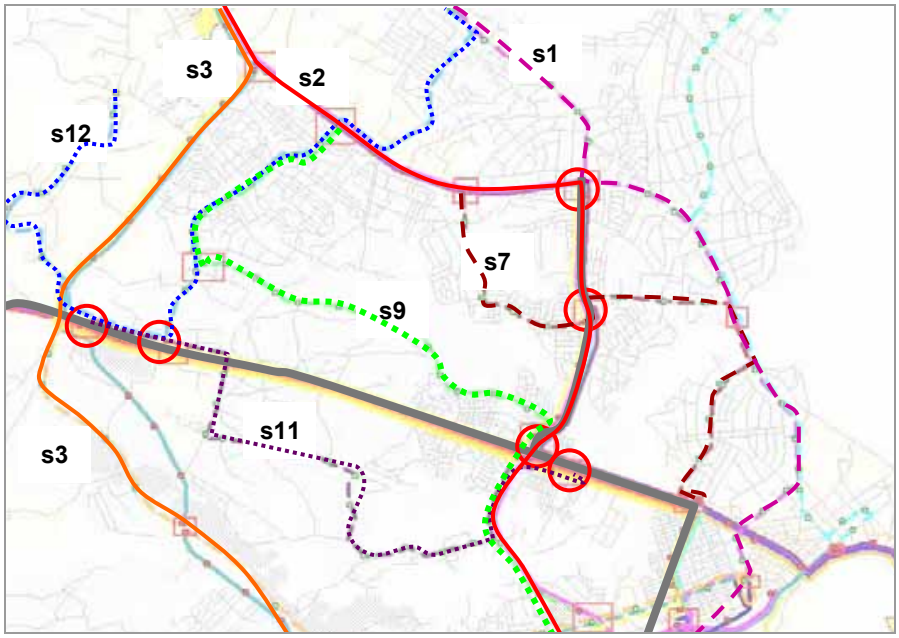



**Figure 15.1.1 Major Interchange Locations for Complementary Buses for Phase 1**

The operational and infrastructure implications of such a secondary/complementary route network is that less infrastructure needs to be built to manage high numbers of daladala at these interchange points. Easy transfers from a complementary bus would simplify the passenger transfer as the pedestrian walking distance and road crossings are greatly reduced. Not all daladala interchanges are affected, but the following locations could be reassessed.

The interchanges at Shekilango and Urafiki Mahakama can be replaced by using complementary buses from south (Mabibo) and north (University and Shekilango areas) accessing Shekilango and Ubungo BRT stations to make passenger connections  Note that the Mabibo route (S11) does a u-turn at Ubungo station while the Shekilango (S12) service does a cross suburb connection from Shekilango to the university, touching the BRT at Ubungo and Shekilango stations.

The daladala interchange at Mlandizi St and Kawawa Rd can be replaced by the complementary bus operating from Mlandizi St entering the busway heading south onto Kawawa Rd connecting to the BRT station on Kawawa before crossing Morogoro Rd to Kawawa Rd south.

The S7 Complementary bus service can eliminate 2 daladala interchanges, the first being at Mwinijuma where the S7 route travels a short section of busway connecting to the Mwinijuma BRT station and the proposed Fire Station interchange where it can divert onto the busway to connect at the station.

The Morocco terminus is a relatively large construction to park and turn buses in the centre of the roadway. The station itself also features extra passenger facilities as a terminus station. The future network however will not require any significant terminus at Morocco but perhaps only require a bus turnaround for short leg BRT services.

There are a number of options for this site:

- Build the Morocco terminus as planned and accept it will be less prominent as a terminus in the future.
- Terminate the Morocco BRT at Dungo (second last station of Phase 1) and for Phase 1 only turning the bus off line at Dungo or the present daladala interchange site at Morocco. This would allow the next station (Phase $ to be placed on Bagamoyo Rd so that complementary buses from Masani, Mikocheni and buses travelling through to Ali Hassan Mwinya Rd are able to connect with this station without the u-turn movement which would be required at Morocco under the proposed plan. The Bagomoyo Rd station would also serve as a bus turnaround for short leg trips.

It is possible that a revision of infrastructure plans at this stage is too disruptive to the planning processes and in that case the building of the proposed system would proceed as planned. The options discussed here are raised at least to provide an awareness of future integration issues.

## 15.4 Risk Analysis for DART Operations

BRT is likely to be the single urban development initiative ever undertaken in Dar es Salaam through a single project and one that will have a major impact on the city development and daily lives of its citizens. The challenges are enormous as the project attempts to manage the many interface issues in implementing a whole new transport system. Despite the large enthusiasm for the project and its obvious positive effect on the city, a detailed risk analysis must accompany all aspects of planning so the issues can be managed more effectively. Risk management must be an integral part of managing

the project to implementation.

This analysis is based on the operating scenario outlined in the (draft) Investors Document (April 2008) released by the DART Agency which aims to provide an overview of DART operations specifically to serve as an information and promotional document to investors, with some technical specifications included in the annexes. This overview document is deemed sufficient to identify planning direction and to conduct a general risk analysis.

With due respect to the present planning process, it is understood that the current operational plan has made certain operational assumptions for the purpose of operational modelling and it is likely that some of these assumptions will be tested to confirm or replace in the more detailed and final planning.

The purpose of the risk analysis is to determine:

- The operational risk from the perspective of the investors and subcontractors, specifically the fare collection company and the bus operators who will need to satisfy themselves on risk exposure.
- The overall risk to the successful implementation of the project.

**The role of DART**

Initially there needs to be a clarification of the role of DART which will lead to the contractual relationship with the fare collector

DART is the system manager – (not a 'regulatory agency' as it is referred in the document) and under its charter is held directly responsible for the quality of service delivery. The DART charter[1] outlines very specific performance indicators for quality of service, operational efficiency and financial performance. As such it needs to retain operational control. It achieves this in the case of bus operators through detailed performance –based contracts for specific services performed (i.e. supply and operation of the buses).

**The extent of function of the Fare Collector Company (FCC)**

In the case of the FCC, the relationship more complex than a simple subcontract, in that alongside the FCC responsibility of managing the fare collection and ticketing, the FCC is subcontracted by DART to manage virtually all daily operations, raising questions as to how DART will be able to retain operational control and how it will create the incentives (also checks and balances) to manage the FCC.

Specifically consider:

- The FCC will be assigned the entire ITS function encompassing the control centre and scheduling, the fare collection and ticketing and the vehicle management. However, the interface between the control centre and the traffic signal priority system is not mentioned in

[1] The Executive Order establishing the DART agency (2007)

the document[2]. The operations control is a large and central activity quite removed from the speciality of fare collection and ticketing.

- The scheduling task carried out by FCC is a task that fundamentally affects the cost structure of the business. A conflict arises as the FCC is not compensated on the basis of cost efficiency but on passenger volumes (percentage per ticket sold). Given that cost efficiency and service quality (affecting ticket sales) are often counteractive, how is this reconciled? To illustrate this, what would prevent the FCC from implementing more generous bus schedules to improve service frequency (thereby improving service levels to enhance the ticket sales) but at a higher cost? Clearly the incentives are present for this to occur, as operational efficiency is not a key driver in the performance of the FCC.

The risk to DART is:

- Lack of operational control over a basic cost aspect of the business and its operational efficiency;
- The intention for DART to give the Fare Collector 'parameters in which to schedule the service, verify compliance and regulate the service in meeting demand' - how would it deal with poor performance of the FCC? What mechanisms does it have to control FCC behaviour and once the FCC has invested; how to remove a poor performer?

**Daily scheduling under the FCC**

Under the section 'system scheduling and control' there is a methodology outlined where the FCC schedules buses on a daily basis, advises operators and programs this schedule into the electronic 'logic' unit on the bus (to give drivers the trip instructions).

This raises numerous issues:

Firstly, bus operations are relatively consistent on a daily basis and schedule changes are usually made on an exception rule (catering for changes such as special events or occurrences) or periodically where changes in demand require service adjustments.

Secondly, changing schedules daily is disruptive for the operator who needs to roster staff and plan vehicle movements on at least a weekly basis. How can operators be expected to keep staff on stand-by to cope with schedules that vary on a daily basis? A monthly/weekly driver roster is an integral and consistent part of any bus operation.

Thirdly, the reason for daily schedule changes is stated as being the demand data sourced from the ticketing turnstiles. How this determines actual demand (and whether this is relevant for the following day) is not proven. Plotting trends over time could be beneficial but it is unlikely that daily changes are

[2] The FCC is assigned to purchase, install and operate all fare collection equipment, control centre and vehicle management. The traffic management equipment (priority signalling) is an inherent function related to vehicle management but has not been mentioned in the Investors Document.

useful or appropriate. Furthermore the proposed flat fare concept does not ascertain origin-destination demand patterns as the exit point for the passengers is unknown. Much of the passenger trip data collection capability of the smart card system is lost in a flat fare system. As a result, the source data for daily schedule changes is unreliable at best.

**Monitoring services and the penalty regime**

Another unclear relationship is between the FCC and the bus operator. The bus operator contract with DART is a clear principal – client relationship and as such DART would be expected to manage the contract. The proposal includes a function where FCC 'monitors' contract performance and divides the kilometres between operators. The FCC would also be able to penalise operators for performance failure. Subcontracting the management of the contract to a third party (FCC) becomes problematic because FCC acts as an 'agent' for DART, one with a high level of control. In many ways DART has subcontracted out its essential control and management role.

As such, DART would have to assume that the FCC will act in its interest, and treat operators fairly under the terms of the contract. Under 'plain sailing' this could work, but when conflict arises, operators can challenge the FCC actions by appealing to Party A in the contract – the DART agency.

The involvement of FCC is this expansive role would require a contract with well designed incentives, and an active means whereby DART can manage outcomes. This will be difficult to achieve and a better solution is to develop the operational management capacity of DART and 'ringfence' the operations of the FCC to fare collection and ticketing.

This leads to another issue, being the lack of mention of a regulatory procedures manual (RPM) that guides the actions and behaviour of DART (or the FCC in this case) in managing the contract. The RPM is a 'yardstick of agreed procedures' to provide consistent and equitable treatment of contractors addressing a major risk concern of operators being an assurance of fair and equitable treatment under the contract manager.

The RPM is essential to govern the penalty system as the impression is that the FCC could be tallying up penalties on a weekly basis leaving the operator to argue his case for full payment. A cumulative demerit points system for service performance is better than weekly cash penalties as it shows longer term and overall performance trends of operators.

The risks to address for DART are to find a balance between introducing and building technical expertise and contracting out the essential control. For the bus operators the risk is wether they can be assured of fair treatment in the contract relationship.

**Price elasticity and the flat fares concept**

The Investor's Document outlines a potential risk relating to price elasticity citing the fact that "most commuters fall under a low income bracket and will be sensitive to changes in DART fares".

This price elasticity risk becomes more acute by the proposal to introduce a flat fare which is a single ticket cost for all travel, being for short or long distances. The cost of this single ticket will be

comparatively higher to cover the cost of longer distance travel.

A distance based fare is more equitable for a number of reasons:

- The higher comparative cost of a flat fare penalizes short distance travellers whereas a distance based fare charges equitably for distance travelled.
- While distance-based fares cover actual distance travelled, a flat fare charges extra for each transfer (even if only across a short distance) and many of these transfers are 'forced' by the new trunk /feeder design[3]. This further increases the cost of the journey.

Presently, most passengers pay 300 Tzs for a single trip and a proportion of passengers pay twice when incurring a transfer thus paying 550-600 Tzs. Travel surveys have shown that on average passengers pay 320 Tzs.

Under the proposed flat fare regime the minimum fare will be 400 Tzs and with a smart card costs an extra 100 Tzs for each transfer. Without a smart card another full fare is payable when transferring buses. The comparisons between existing fares and new fares are shown as follows:

- Present minimum fare of Tzs 300 becomes minimum Tzs 400 is a 33% increase.
- According to travel survey data the current average fare is Tzs 320, thus:
- A new flat fare (400 Tzs) increases the price by 25%.
- With one forced transfer (+100 Tzs with smartcard) increases cost by 58%.
- With two forced transfers (+200Tzs with smartcard) increases cost by 120%.
- Without a smartcard, these transfers would increase cost by 150% and 275% respectively.
- Passengers presently travelling longer distance (say Tzs 400) would gain no net saving while passengers incurring a full double fare (Tzs 600) would have a saving of 33%.

While per ticket increases may be deemed affordable or acceptable in terms of better value (comfort /faster travel times) it should be considered that most people travel 10-12 trips per week; so the impact on a weekly travel budget ranges from 1000 to 2800Tzs assuming smart card use.

When a forced transfer occurs, the increase is an astounding 58-120% which is a large impost on a family budget. Note that with competing daladala removed there is no choice available.

For longer distances however, a saving occurs for the user but this is not beneficial for system funding as this is a reduction on fares presently being paid, and therefore a revenue loss to the system where passengers already demonstrate that they are prepared to pay for the journey distance.

The proposal for a flat fare regime is generally for two stated reasons (also mentioned in the DART business plan) being firstly, that a flat fare subsidizes poorer people living in the distant outer suburbs

[3] *The issue of forced transfers on a trunk/feeder system is in contrast to present daladala operation which has many route permutations offering direct travel to a wide choice of destinations for a single payment.*

and secondly, that a flat fare does not require the smart card to be checked on exit thus speeding up the exit from stations. Both these concerns can be answered as follows: Local evidence does not confirm a clear demarcation in socio economic distribution where the poorer citizens necessarily live on the city outskirts. Many poor people live in the city areas and poor people in outer suburbs also do short trips in their local areas, so the presumption appears to lack basis.

On the second issue, swiping the smart card at exit from stations does not need to slow passenger exit as simple 'swipe past the post' validators can be used. There causes no obstruction or delay. The system can be designed to ensure passengers will swipe at exit by deducting the maximum fare at entry and refunding the difference at exit (charging according to distance travelled); any passenger not swiping out will simply pay the full fare.

Distance–based data collection is a major benefit as it provides origin-destination data for essential service planning. Under a flat fare regime the system knows where passengers boards, but has no information as to where they alight.

The above discussion demonstrates that the flat fare concept is a substantial risk to public acceptance as it impacts significantly on the cost of travel. Enthusiasm for the benefits of the new system should not overshadow day to day budgetary concerns and the ability or willingness to pay for it.

**Fuel prices**

To manage the risk of rising fuel prices, a fuel cost index must be fully addressed in the contract. The Investors Document claims operators will be "partially insulated from the full risk' by payment adjustments, but any fuel price risk not addressed is likely to be added into the 'per km' price as a contingency. In the light of recent price explosions, operators are unlikely to agree to carry any fuel cost risk. Similarly, the document's suggestion of hedging against a fuel price increase through a 'forward contract' with oil companies is unrealistic as that contract will have an in-built contingency (i.e. the price being loading to cover risk of increase). Would DART be prepared to pay a higher fuel component from the outset to take this into account?

**Resistance from the public and from other stakeholders**

The Investors Document suggests an 'aggressive marketing strategy' to create awareness and achieve public acceptance. While a marketing and communications strategy is important and essential, it is perhaps simplistic to think all stakeholder issues can be smoothed over or addressed by positive image marketing. Some stakeholders at least will exhibit resistance due to real and present concerns (like the fare increases for example) and will need these issues to be categorically addressed. Institutional stakeholders (such as the Police) may show resistance a change of role and have reservations on their role and associated jurisdictional issues. Such key stakeholders need to be brought 'on-board' and incorporated as part of the solution, being actively consulted and able to make a real input to planning.

A full stakeholder analysis and a communications plan is a most essential part of project planning. Substantial risk occurs when essential stakeholders are ignored and the project does not give sufficient

weight or regard to their concerns.

**Implementation and institutional capacity building**

Experience shows that BRT systems planned and implemented by city administrations often fail, especially if the project team is unable to withstand political expedient decisions. Implementing an integrated BRT is a very major task for any city to undertake and requires intense work on the interface issues especially the institutional and organizational issues.

Dar es Salaam has made a good start with the early formation of the DART agency, but it cannot be stressed enough that the capacity within the agency needs to be developed with sound planning assistance by public transport professionals. Technical assistance alone will not implement the project; it needs substantial capacity in the DART Agency if it is to successfully carry the responsibility of implementation.

**Risk assessment by financiers**

A key limitation for bidding parties is the availability of finance to purchase buses. While various assistances can be given on account of the nature of the investment, ultimately the main concern of the financier will be: What happens if things go wrong? The concerns of the financier will be instrumental in designing the business model to ensure the operator and ultimately the financier carries acceptable risk.

Practical concerns a financier will need to see addressed are:

- Are there experienced BRT operators involved?
- Do the operators have experience in running and maintaining large numbers of buses?
- Do they understand cost control and pre-emptive maintenance?
- What are the potential risks associated with the workforce culture?
- Does the operator have competent and experienced maintenance staff?
- Does the operator have a strong capital base and cash reserves?
- Do they have access to sufficient working capital?
- Do they have robust cash flows to survive cost shocks or surprises?

**Conclusion**

While this risk analysis may not be fully comprehensive it covers important structural issues that need to be well designed and managed. Awareness of risk is a good first step to addressing the issues in the planning process and to determine good management strategies.

# Chapter 16 Short-term Measures for Dala Dala Operations

This discussion relates to the short-term measures that can be adopted to improve the daladala operations while the major reforms of the industry are taking place. As emphasized in *Chapter 8* these actions are short term and will be ineffective if the major structural maladjustments are not remedied.

This approach involves a community-based approach with the involvement of three stakeholder groups – the government as a key stakeholder, an owner/operator community group and a management group.

The problem must be approached with recognition that the daladala industry is a struggling industry operating and surviving on the lowest common denominator of cost and quality. A keen appreciation of the insecurity and vulnerabilities faced by the players is essential in order to develop the necessary solution.

The International Labour Organisation (ILO) list seven forms of 7 forms of socio economic security[1] (labour market security, employment security, job security, skill reproduction security and representation security) the lack of which leads to livelihood insecurity of the poor and fear of losing their subsistence (Kedir 2005:50). All these factors are applicable to the level of insecurity felt by drivers and conductors in their casual and unreliable employment situation and their situation is a direct product of the precarious economic situation of daladala operations. In the survey of drivers all respondents indicated a preference for reliable work arrangements over the uncertain employment arrangements they presently experience.

The daladala industry is basically unmanageable due to it fragmented nature (individual ownership) and operating largely outside the proper management structures. Formalizing such a fragmented industry will require a committed effort to consolidate through an effective consolidation framework designed to deliver mutual benefits to regulators users, owners and operators alike.

An 'effective consolidation framework' will require the involvement of all stakeholders who perform their function based on their relevant resources and abilities and developing proper interaction and relationships with other stakeholders.

[1] Abbi Mamo Kedir: Understanding urban chronic poverty: Crossing the Qualitative and Quantitive Divide. Environment & Urbanization Vol 17 No2 October 2005

One key stakeholder is government, who mostly have the resources (financial and legal) to create a basis for a solution but relies heavily on its role as an administrator to carry out the task properly to achieve its aims. As a key stakeholder it must understand these complexities of the issues facing operators in respect to providing public services and the vulnerabilities under which they operate. Hence the government must (in part) relinquish the role and attitude of being 'regulator' and adopt the role of 'manager', seeking to understand the issues and how to manage them toward the set objectives.

The mechanism of government should be 'demand oriented' which (by definition) is to be consultative and responsive. Setting strategic policy toward set objectives and allowing the formation of tactical strategy at a local level with the community is a way of allowing management to adapt to changing situations, respond to new information as it arises and to changing needs.

Furthermore the government's span of management includes setting the regulatory framework in order to create suitable and favourable conditions to assist the on-ground management of the problems. These would include:

- Creating through the operator associations such as DARCOBOA, cooperative alliances (area based) to consolidate operators into community groups or companies to improve representation and develop structures of managerial authority and accountability.
- Developing codes of conduct and operational standards (either voluntarily or tied to the 'right to operate')which are also supported by resources.
- Creating access to credit to upgrade equipment including emergency fund facilities to manage shocks as they occur (for example, an industry fund for accident & sickness administered by the cooperatives for member benefit).
- Improving the security of employment for drivers and conductors through enforcing labour rules as part of the 'right to operate" (permit condition).
- Once organized and accountable, the industry may be recipient of some form of limited subsidy for providing special services requested by government (e.g. student travel).

While government mechanisms can be developed more effectively, the second stakeholder group is the community, involving owners and operators as part of the organized community groups. For the government to take a community based approach, requires both the organization of a communal voice, and the linkages to other support groups (including other cooperatives facing similar issues).

With a targeted and problem solving approach by government and an organized community of owners and operators through cooperatives or companies the processes will develop to ensure better service delivery and continuation. A pilot project is strongly suggested to develop a learning experience that can cross-fertilize a wider approach. .

A third stakeholder could be a management group who are assigned the task of managing the project. DARCOBOA may be an ideal candidate for this task and the representation on this group would include representatives of government, NGO's and the community. One primary aim of this group is

to gain an understanding of the real issues in order developing adaptive policies to manage reach the objectives. It is therefore necessary that a bottom-up approach be taken so that the management group recommends the policy framework to create the conditions for project expansion and continuation.

In summary, the mechanism will be a collaboration of stakeholders, working toward a community based solution, with each player contributing their resources and abilities toward mutual objectives.