
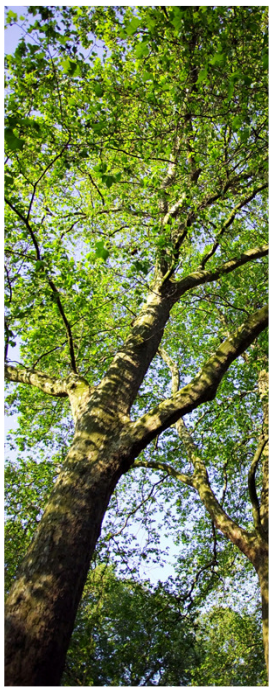


NATS+ Technical Note

Defining Bus Rapid Transit for Norwich

May 2010

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Content

Executive Summary

To date, studies considering the transport opportunities and threats created by large scale growth in the Greater Norwich area suggest that a bus-based public transport system is likely to offer the most appropriate solution.

Bus Rapid Transit (BRT) has been considered for a number of corridors to the City Centre from proposed development sites, to complement a number of other core bus routes. However, BRT is not a prescriptive solution and a specification must first be agreed for the Norwich area. This note identifies that BRT for Norwich could include:

- High capacity, semi-low floor, rigid interurban buses
- A high quality of vehicle with features as standard, such as double glazing, air conditioning and information screens
- Disability Discrimination Act (DDA) compliant vehicles and infrastructure
- An environmentally friendly vehicle, potentially utilising an alternative/emerging fuel source such as biogas
- A service frequency of at least every 10 minutes during the day
- A series of priority measures such as bus lanes and bus activated traffic signals (Selective Vehicle Detection) at key junctions
- Bus priority measures along the urban sections of each corridor where feasible
- A simple, accessible, off-bus ticketing system, including a range of added value tickets such as weekly and monthly passes
- Upgraded bus stop infrastructure to include shelters with real-time information, lighting, seating and static displays at every stop
- Bus stops every 600 metres in urban areas and at strategic points in less developed areas
- A fully branded service, creating a clear and attractive image for BRT to include easily identifiable vehicles, stops, information and signage
- Enhanced use of Intelligent Transport Systems (ITS) to improve journey times and journey time variability.

1. Introduction

The development of a new planning strategy (the Joint Core Strategy) for the Greater Norwich area has highlighted the need for a major shift in emphasis towards public transport to support large scale growth within the Norwich Policy Area.

Work is ongoing to align NATS with the Joint Core Strategy and will be known as 'NATS+'. The output of this work will be an Implementation Plan, setting out what NATS+ will look like on the ground. NATS+ envisages that BRT will play a key role in the future of transport for the Greater Norwich area.

Early work on the NATS+ Implementation Plan has identified the long term aspirations for the transport network at a strategic level of detail. These aspirations include some form of BRT on up to six corridors. A further eight corridors have been identified as potential Core Bus Routes.

BRT is a broad term given to a variety of transportation systems that, through improvements to infrastructure, vehicles and scheduling, attempt to use buses to provide a service offering a step change in quality relative to an ordinary bus route. Individual BRT systems may adopt different combinations of improvements, although many of these improvements are shared between BRT systems. The goal of such systems is to at least approach the service quality of rail transit while still enjoying the affordability of bus transit.

There is thus no single standard model for BRT and many of the existing BRT systems in the UK exhibit significant differences in character. However, it is essential that at a local level BRT should conform to a specified system-wide standard.

It is therefore envisaged that BRT for Norwich will feature a standard package of improvements across all corridors identified in the NATS+ Implementation Plan as 'BRT Corridors'. However, the characteristics of a BRT system for Norwich and the features that will distinguish 'BRT Corridors' from 'Core Bus Routes' have yet to be defined.

To be able to comprehensively assess and test the viability of BRT routes for Greater Norwich, it is imperative that a definition of what BRT will comprise in the context of Norwich is first agreed. This Technical Note proposes a definition of BRT in the context of Norwich with reference to the following elements:

- Image and branding
- Corridor alignments
- Stops/stations
- Vehicles
- Fares and ticketing
- ITS
- Service and operations plan

The previous work undertaken to develop a vision for high quality public transport connections for the growth areas (as set out in Chapter 3 of the Mott MacDonald report *Greater Norwich Joint Core Strategy – Public Transport Requirements of Growth*) has been used as the starting point for this work to define the modal characteristics of the BRT corridors and the service levels to be assumed for each corridor.

2. Key Local Issues

A summary of the key factors currently impacting on bus reliability and journey times is given here for reference.

The main focus of corridor development at this stage has been to develop links to the major housing and employment growth areas beyond the Outer Ring Road (ORR) identified by the emerging Joint Core Strategy.

2.1 Growth Areas

An opportunity exists to create Public Transport-Orientated Developments (PTODs) with high levels of bus priority measures built in from the outset. As such it has been assumed that access and egress from the developments will be bus friendly and result in no delays to services.

2.2 Rural and Inter - Urban Areas

It is generally considered that the rural sections of route between the growth areas and the outskirts of the Greater Norwich urban area will not require any bus priority measures. The majority of corridors consist of Class 'A' primary distributor roads, hedgerows, verges and blocks of woodland. There is little congestion and it is unlikely that an investment in physical priority measures in these locations would generate the required results if subjected to the Cost Benefit Analysis process.

2.3 Approaches to the A47

For corridors to the south and west of Norwich, the intersection with the A47 trunk road creates the first major obstacle to delivering more rapid and reliable bus services.

Bus priority on the approach to roundabouts, such as those currently in place at Thickthorn, should be considered where possible for each corridor, and lengthened where already in existence to compensate for the higher volume of general traffic predicted to be generated by the growth areas.

Where these junctions are signalised, Selective Vehicle Detection (SVD) should be implemented on all bus approaches to provide priority.

2.4 Approaches to the Outer Ring Road

Previous bus priority studies, BusNet data and existing modelling data suggest that the junctions with the ORR create the greatest level of congestion and journey time variability for bus services travelling to and from central Norwich.

A greater level of bus priority at these junctions would be required to achieve a step change in the quality of public transport, yet constraints in the form of historic buildings and trees are evident at many junctions. Where possible bus lanes should be created or lengthened on both the inbound and outbound approaches to enable buses to reach the front of any traffic queues. There may be scope to create new bus lanes on certain corridors, but realignment of existing carriageways may be required and delays to general traffic are likely.

SVD should be implemented at all signalised junctions to create more rapid transit for buses and shorter end-to-end journey times.

2.5 Approaches to the Inner Ring Road

As with the ORR, previous studies and evidence from BusNet show that the Inner Ring Road (IRR) approaches are a source of delay to bus services. The historic nature of the City Centre is such that in many cases there is little scope to widen roads, and capacity for general traffic is also an important issue.

Schemes have been suggested for certain junctions, but the implementation of SVD at all signalised junctions offers the greatest potential for journey time savings for buses.

As road capacity is at a premium in the City Centre and immediate environs it is imperative that on-street parking restrictions are enforced, particularly on BRT corridors. The development of London-style red routes may encourage a change in parking behaviour from drivers, but without proper enforcement this would not offer value for money.

2.6 The City Centre

The *Joint Core Strategy Public Transport Requirements of Growth* study highlights issues relating to bus stop space and capacity within the City Centre. The recommendations of this report are still valid and the overall bus stop availability in the City Centre, particularly for high frequency services will require a significant increase in capacity.

As mentioned in Section 2.5 above, enforcement of parking restrictions is essential and will be required in order to deliver an efficient service.

3. Proposed Definition of BRT

This section draws upon the findings of the *Joint Core Strategy Public Transport Requirements of Growth* study, identifying the proposed characteristics that will define a BRT system for Norwich and the features that will distinguish 'BRT Corridors' from 'Core Bus Routes'.

3.1 Image and Branding

The vision for a BRT service for Norwich should start with the overall image, visual identity and branding of the service. This is fundamental to the perception of the service as offering a step change in quality relative to existing bus services.

The visual identity and branding of the service should be strongly co-ordinated across vehicles, infrastructure and information so that the service is perceived as an integrated system even if in practice different parties are responsible for operations and infrastructure.

3.2 Alignments

An ideal BRT service would operate either on an exclusive right of way or with a significant degree of segregation from general traffic delivered through the provision of on-highway bus priority measures. However, most UK BRT systems have adopted a more pragmatic approach to alignment design with segregated sections of route typically making up less than 50% of the total corridor length.

The width of many of the existing highway corridors in Norwich that have been identified as candidate BRT corridors is insufficient to enable the provision of an exclusive right of way without major adverse impacts on buildings and the environment. It is suggested that in the case of Norwich it is neither practical nor strictly necessary to provide segregation of BRT vehicles from general traffic over the majority of the corridor length, as long as a 'whole corridor' approach to bus priority is adopted for the corridor concerned.

As discussed in Section 2 above, the majority of traffic delays to bus services on radial routes are experienced on junction approaches. A whole corridor approach would seek to implement measures to assist the movement of buses on all junction approaches, but would not necessarily provide continuous bus priority between junctions except where this would be straightforward and cost effective.

Any corridor selected as a BRT corridor should therefore offer the potential to implement a whole corridor approach to bus priority including most of the following features:

- Short sections of exclusive right of way;
- Significant lengths of on-highway bus lane;
- The use of ITS to assist the movement of buses at locations where it is not practicable to provide physical bus priority measures;
- Low-cost infrastructure elements to increase the speed and reliability of bus service such as bus boarders and kerb realignments.

It is the implementation of a whole corridor approach to bus priority, rather than isolated measures at congestion hotspots that will distinguish 'BRT Corridors' from 'Core Bus Routes'. Should feasibility studies for certain candidate BRT corridors identify that a whole corridor solution for a particular corridor is not deliverable, then the corridor concerned should be designated only as a Core Bus Route.

Within Norwich City Centre consideration should be given to the creation of additional bus only streets or 'transit malls' by dedicating all lanes of an existing to the exclusive use of buses.

3.3 Stops / Stations

As discussed in the *Joint Core Strategy Public Transport Requirements of Growth* study, three different categories of bus stops can be assumed within the Greater Norwich area; BRT stops, Terminal and Interchange stops, and conventional bus stops.

BRT infrastructure will incorporate both BRT stops along a corridor to the city centre, and at least two terminal stops. The proposed specification for each is shown in the table below.

Figure 3.1: Proposed Specifications

Measure	BRT Stops	Terminal and Interchange Stops
Basic shelter	√	
Enclosed waiting area		√
Maps and static information panels	√	√
Raised kerb	√	√
Level platform, one vehicle long	√	√
Branding	√	√
Ticket machines (depends on ticketing approach)	√	√
Seating	√	√
Real-time information provision	√	√
Lighting	√	√
Help-point		√
Good pedestrian linkages (e.g. good, nearby crossing points)	√	√
Coloured surfacing on carriageway	√	
Cycle parking		√
Distance between stops	600m	N/A

It is envisaged that the distance between stops will be a minimum of 600 metres in built-up areas. This will create shorter end-to-end journey times and make the service more attractive to passengers travelling to the City Centre from the growth areas. It should be noted, however that there will be sections of route where stops are much more widely spaced than 600 metres, particularly in more rural areas and the provision of stops must always take into account the demand likely to be generated in the surrounding area.

3.4 Vehicles

As demonstrated by the successful Kent Thameside 'Fastrack' BRT network, the use of specialised vehicles with tram-like characteristics is not an essential feature of a BRT system. However, the appearance and quality of the vehicles selected for use in Norwich will be important to the perception of BRT as offering a step change in quality relative to existing bus services.

There is much that can be done to raise the visual appearance of essentially standard buses to stand out from an existing bus fleet by adopting a radical livery design and specifying a high quality interior with features, such as air conditioning and leather seats as found in many private cars.

Double deck vehicles are efficient people movers, but may not offer the best overall passenger experience. Customers often prefer to travel downstairs where they feel safer due to proximity to the driver and to exits. Double deck vehicles can also suffer from increased dwell time at stops with passengers exiting delaying the boarding of other passengers as they file down the stairs.

The use of such vehicles may make it more difficult to portray the new services for the growth areas as offering a step change in quality relative to existing bus services.

For these reasons, double deck vehicles are not recommended for BRT services in Norwich.

Articulated buses are perceived as having tram-like qualities, but require significant additional kerb space at bus stops and interchanges and could not be easily accommodated within the historic centre of Norwich where the existing on-street bus stop kerb space is already being used to its full capacity.

A recent UK innovation in bus design has been the development of a tram-like vehicle for BRT services based on a standard articulated bus chassis, but adopting a radical approach to the body design and interior layout. The Streetcar FTR vehicle developed by Wrightbus and FirstGroup is an 18.7m articulated vehicle with segregated driver's cab, air conditioning, upgraded lighting and side-on lounge style seating. There are now operating within cities in the UK, including Leeds and York.

These vehicles have only 37 seats but space for 76 standing passengers. Given the length of journey and nature of the roads used it is not felt that a vehicle with such a low proportion of seating would be well suited to use on BRT services linking the major housing and employment growth areas with Norwich City Centre.

It is therefore suggested that the preferred vehicle type for use on BRT services in Norwich would be a high capacity semi-low floor rigid interurban bus up to 15 metres in length.

3.4.1 Preferred Vehicle Type – Semi Low-Floor Interurban Bus

Journeys of 20 minutes or longer and those which travel at speeds in excess of 40 mph generate different requirements from passengers compared to short bus trips made entirely on urban roads with a 30 mph speed limit. As such it is recommended that BRT services linking the major housing and employment growth areas with Norwich City Centre should be operated with semi-low floor interurban buses.

Semi-low floor interurban vehicles range from 13.5 to 15 metres in length with a seating capacity of between 49 and 57, and a further 28 maximum standees. These vehicles offer a mix of low floor and raised seating areas, with both front and centre access points being fully wheelchair accessible.

Figure 3.2: Semi Low-Floor Interurban Bus - An Example

Figure 3.3: Semi Low-Floor Interurban Bus - An Example

These vehicles could be fully double glazed throughout, with distinctive seating and flooring styles and lighting to create a modern, clean travelling environment. Seating capacity would need to strike an appropriate balance between maximising seating capacity and offering adequate legroom.

Air conditioning should be considered as standard throughout the BRT fleet, as would be electronic destination displays at front, side and rear in accordance with DDA standards. Electronic variable message signs or colour thin film transistor (TFT) screens could be fitted to the interior of the vehicle to provide information to passengers during their journey and to indicate location and next stop information. Global Positioning System (GPS) tracking should be fitted to all vehicles linking to the BusNet system. This would also allow for the activation of SVD at appropriate junctions through the BusNet system and central control room.

For security CCTV could be fitted to the interior and exterior of the vehicle.

Vehicles could also be fitted with mobile internet equipment to enable free wi-fi access to be offered to BRT customers as an added value feature.

Regulations made under the DDA require all new buses to be fully accessible to disabled people so accessibility will be a given for new vehicles of any type.

3.4.2 Interurban Coach

Where demand is sufficient to support the operation of an express service on a BRT corridor in addition to a normal stopping service it is recommended that the vehicles used on such a service should be interurban coaches. There is potential for this type of service to operate between Attleborough, Wymondham and Norwich via the A11 trunk road, travelling at higher speeds than conventional bus services. The use of coaches creates a more comfortable, quieter service more comparable to that of the car.

The capacity of these vehicles would be 46 seats, based on an accessible 12 metre coach with a wheelchair space incorporated within the passenger entrance.

Specification would be similar to that of the BRT buses detailed in 3.3.1, but with airline-style seat back tables and tinted glass as additional features on each vehicle.

Figure 3.4: Interurban Coach Facilties

3.4.3 Engine Fuel Options

With the climate change agenda receiving an increasingly high profile, the provision of a public transport service using environmentally friendly vehicles will be expected by residents of the major growth areas and by stakeholders concerned about the sustainability of large scale growth on greenfield sites.

The costs, benefits, opportunities and risks of using alternatives to diesel powered vehicles to serve the BRT corridors should therefore be considered before key investment decisions are made regarding the provision of depot infrastructure and procurement of vehicles.

Since the publication of the *Joint Core Strategy Public Transport Requirements of Growth* report, Norfolk County Council has initiated investigations into the potential for use of biogas as a vehicle fuel. The results of this work should be used to inform decisions regarding the procurement of vehicles for use on the BRT corridors.

Hybrid diesel-electric vehicles and electric trolleybuses as proposed for the Leeds 'New Generation Transport' (NGT) BRT scheme are further options offering environmental benefits over diesel powered vehicles.

3.5 Fares and Ticketing

To ensure reliable journey times and maximise the potential that exists in Norwich for faster boarding and reduced bus stop dwell times, BRT services should operate exclusively using an off-bus or pre-paid ticketing system, with no fares collected by the driver.

There are two technologies available that would achieve this aim; smartcards and mobile phone ticketing. Both systems are already in use elsewhere in the UK and can be relatively easily implemented on-bus through either new ticket machines or upgrades to existing systems.

The off-bus aspect of both systems would be slightly more complex and would require an educational campaign to inform potential passengers of the process of ticket purchase and use. Additionally, a secure back office system would be required with a number of outlets where top-ups could be made to cards or phones.

Regardless of which technology is ultimately chosen for BRT in Norwich, the system must be simple, reliable and achieve the aim of reducing the time spent at stops and speeding up overall journey time. A budget must also be set aside for educating the travelling public about the ticketing process.

3.5.1 Fare Structure

A simplified fare structure should be applied to all BRT services. Multi-modal tickets should be made available as well as inter-operability between operators

3.6 Intelligent Transport Systems

Integrated ITS providing seamless real time information for customers before and during their journey will be necessary to build confidence in the BRT service and contribute to the overall perception of a service offering a step change in quality relative to existing bus services.

ITS could also be employed to deliver bus priority at signal-controlled junctions while minimising delays to general traffic. Many of the building blocks for this are already in place, or under development, in Norfolk and Norwich.

3.7 Service and Operations Plan

The establishment of ‘turn up and go’ frequencies is essential to achieve the step change required for public transport in the Greater Norwich area. This level of service means that passengers can have the confidence to turn up at a bus stop without needing to consult a timetable, knowing that they will never have a long wait for a service.

Departures every 5-6 minutes should be considered during peak periods on services to and from the City Centre. During the interpeak period a minimum daytime service interval of 10 minutes should be maintained to meet the requirement for a ‘turn up and go’ service.

Ultimately a 24 hour service may be required to link growth areas to Norwich, but there may not be sufficient demand during the first few years to justify this. As such BRT services should aim to operate from 0500 to 0100. During the evening, a 20 minute service should operate from 1900 onwards, possibly reducing to half-hourly after 2300 depending upon the demand generated by each growth area.