Automated and Space Efficient Vehicles

niches

GUIDELINES FOR IMPLEMENTERS OF
Group Rapid Transit (GRT)

NICHES+ is a Coordination Action funded by the European Commission under the Seventh Framework Programme for R&D, Sustainable Surface Transport

What is it about?

Characteristics

Group Rapid Transit (GRT) is a new form of collective public transport (PT) using small automated electric 'Cyberbuses' to provide scheduled and/or demand responsive feeder and shuttle services connecting e.g. a parking lot with a major transport terminal and/or with other facilities such as a shopping or exhibition centre.

The system is rather like a lift or elevator, in that the passenger presses a button at the stop to call the vehicle and then another on the vehicle to select the destination. The 'Cyberbus' will arrive and then go directly to the selected destination unless called by other users to pick up or set down along the way.

Services can be on demand. This ensures waiting times are kept low and vehicles are only used when there is a demand. Scheduled services are also possible to optimise capacity during periods of high demand.

Parkshuttle,
Photos: '2getthere'

Key Benefits

GRT provides:

- a flexible alternative to shuttle bus schemes;
- highly efficient operation as cyberbuses only operate when there is a demand;
- low operating costs compared to bus or tram schemes as drivers are not required;
- both scheduled and on-demand services are possible depending on the need (e.g. peak vs. off peak);
- simple accessible services for all, similar to a lift;
- low waiting times;
- pollution reduction as vehicles are automated, electric and quiet.

Example: Parkshuttle at Rivium, Rotterdam/Capelle aan den Ijssel, the Netherlands

ParkShuttle is an automated system of driverless electric buses connecting the Kralingse Zoom metro station and car park with the Rivium business park. The system was built by the '2getthere' company and is operated by the Netherlands public transport (PT) operating company Connexxion. The system became fully operational in early 2006. It uses six buses, each with seats for 12 and a maximum capacity (including standing passengers) for 24.

The vehicles are electric and provide clean, green, efficient and sustainable public transport with low waiting times (1.5 to 3 minutes on average).

Start up costs are reckoned to be more expensive than for a conventional bus scheme, but the operating costs are less.

Is this something for us?

GRT offers the advantages of a tram with the flexibility of a bus. Clean, quiet automated vehicles support transport, environmental, economic, and social inclusion policy objectives. GRT is complementary with existing public transport and can be used as a feeder system to improve accessibility by linking existing services and modes in cities.

Economic benefits include:

- cost efficiency;
- on-demand service;
- low waiting times.

Check list

City size	GRT tends to be thought of as providing a 'last mile' solution, although the potential is greater.
Costs	Less than for an equivalent bus scheme using drivers, and less than for a tram. Capital costs are needed to procure the cyberbuses, provide the control system/centre and a depot for vehicle maintenance/ charging; and also to provide and equip the guideway, stops and security measures.
Implementation time	Short - medium term. A scheme might take up to three, and in some cases more, years to implement.
Stakeholders involved	• Operating company; • Local authority as the infrastructure owner; • National government for safety certification; • Local community and users.
Undesirable secondary effects	Possible visual intrusion caused by elevated sections of guideway, if needed, and severance caused by sections at-grade.

A modelling exercise conducted within the CityMobil project for a system of GRT serving as feeders to mainline transport terminals in the City of Gateshead, UK, showed a Benefit Cost Ratio of 2.48 (considering revenues only and excluding any social benefits) for a scheme with a lifetime of 30 years and involving 23 kilometers of guideway, 36 stops, 43 vehicles and a fare of €2.2. The capital cost was €34.6M and the first year operating and maintenance cost was €3.3M. The average waiting time was estimated to be 3 minutes in the peak period.

"The new Rome exhibition centre is a very dispersed site with long distances between the car park and station to the exhibition halls. A means of transporting visitors between these sites is obviously required, and the city authorities are convinced that a GRT system will provide the most cost effective solution. An on-demand service using automated vehicles will be in keeping with the innovations that will feature strongly in the exhibitions, and be more efficient and cheaper than a shuttle bus using drivers."

Francesco Bellini, Scientific Consultant, City of Rome, Italy

Morgantown GRT: an existing scheme serving the University of West Virginia, USA
Photo: Dr Jon Bell, Presbyterian College, Clinton S.C. USA

Cyberbus developed by Robosoft for use at the new Rome Exhibition Centre
Photo: City of Rome

Benefits & Costs

Benefits

GRT provides a new system of public transport offering an on-demand service with low waiting times, and with the safety and cost benefits arising from automated i.e. driverless operation.

Significant benefits are:

- reduced operating costs from driverless operation;
- savings from the efficient use of vehicles which are only used when there is a demand;
- potential for full cost recovery from fares;
- low waiting times and hence time savings for passengers;
- reduced noise and environmental pollution locally from using electric vehicles.

GRT therefore provides a potentially sustainable and convenient solution for urban mobility.

Costs

GRT schemes require a segregated guideway and small about 20-person capacity (i.e. mini-bus sized) driverless vehicles. The guideway can be at street level. Representative costs for a variety of systems and 24/7 operations in 2008 prices have been estimated in the CityMobil project and are reckoned to be as follows:

Capital costs:

- buses cost 270 k€ each;
- infrastructure costs 720 k€/km.

Operating costs: are made up from a base cost for 5 km of track and 10 vehicles (including staff) plus additions for infrastructure per km and per vehicle, and for staff per km and per vehicle, which total to **1,150 + 37.0(L-5) + 46.0(N-10) k€ per year,** where L is the length of single track guideway (in km) and N is the number of vehicles.

Parkshuttle stop: press the button to call a Cyberbus
Photos: '2getthere'

Parkshuttle

The Parkshuttle scheme uses six 24-person capacity driverless vehicles operating on about 5 km of dedicated street level guideway with 5 stops. The guideway construction costs include a guidance system using buried magnets, a depot for the vehicles' storage, maintenance and recharging, plus a control centre and system for controlling and communicating with the vehicles. Approximate costs in 2008 prices are reckoned to be:

Capital: vehicles:	1,600 k€
Infrastructure:	3,600 k€
Operating:	650 k€ per year

Operating costs include electricity and communications costs, and 3 staff/day for operations and maintenance during a 5 day, 16 hour/day week. The operating costs would increase if it was required to provide 24/7 operation.

Users & Stakeholders

Users and target groups

There are essentially two classes of users for GRT systems, the end users i.e. **passengers**, and the **buyers** of the systems. Clearly, the buyers must recognise the needs of the end users, but have additional needs of their own.

Passengers include all classes of travellers on trips for all purposes e.g.:

- leisure;
- commuting;
- business;
- people with individual requirements, such as:
  - mothers with pushchairs;
  - travellers with heavy luggage;
  - wheelchair users and other physically disabled travellers;
  - visually impaired travellers.

Their main expectations and needs include accessibility, information, ease of use, comfort, cost, reliability, safety and security.

Buyers may be public transport operating companies or local authorities. Their additional concerns relate to factors concerning operations, maintenance, costs and financial viability.

On the Parkshuttle Cyberbus: press a button to select your destination stop
Photos: '2getthere'

Key stakeholders for implementation

Like buses and trams, GRT schemes are typically procured by a local authority or a public transport (PT) operator, and may be procured through a Private Finance Initiative (PFI). The main actors will be:

- **local authority,** as the planning authority and owner of the infrastructure on which the scheme will run;
- **PT operating company,** as the operator of the GRT system;
- **technology supplier** and system integrator who will provide the buses, the control centre and communications systems;
- **infrastructure supplier** as contractor to implement the necessary civil engineering facilities, including the guideway and stops, and buildings for the control centre and depot;
- **managing consultant** to act as project manager to oversee the overall implementation and ensure co-ordination between the technology and infrastructure suppliers;
- **national government** for certification and perhaps funding;
- other **funding partners** e.g. banks and the developers of the sites served by the GRT scheme.

Other groups that should be consulted will include:

- neighbouring local and regional authorities;
- emergency services;
- local community;
- passenger interest groups;
- special needs groups;
- media.

From concept to reality
Preparation

A proposal for a GRT scheme will generally arise as a consequence of an identified need for a new PT scheme, such as to provide a new P&R scheme or to serve a new development or regeneration area. Planning will then proceed along the usual lines, starting with a feasibility study to confirm the likely level of demand and that GRT is the preferred solution.

Key aspects at this stage

- GRT proposed in response to an identified need;
- Feasibility study to confirm demand and show GRT is the preferred solution;
- Work to win necessary media and stakeholder support;
- Produce scheme/system specification;
- Develop a business case and funding mechanism;
- Prepare EU-PIN (pre-information notice);
- Prepare/publish Invitation to Tender (ITT);
- Receive/evaluate tenders;
- Select contractor/consortium.

The new Rome Exhibition Centre
Figure: courtesy City of Rome

Creating political support
GRT is not yet on the agenda of most planners. They will probably consider a bus or tram scheme first. However, GRT has much to offer, and is highly competitive in many situations. A champion will be needed who can take plans forward and win the support of local politicians.

Feasibility Study
It is usual to employ consultants to estimate demand, investigate alternative schemes/ systems, identify barriers and how to overcome them, show expected costs/benefits, and generally confirm GRT is the preferred solution. The study should identify if a public enquiry will be needed, and what approvals must be obtained to cover the operations, safety and certification of the scheme.

Stakeholder network
It will be essential to win the support of the local community, residents and businesses. It is therefore suggested to involve the media and establish user groups to inform users of the benefits and progress, and to learn their views and opinions. These will need to be taken into account.

Scheme/system specification
Again, it is usual to employ (the same or different) consultants to translate the results and recommendation of the feasibility study into a scheme/system specification.

Business case
A separate business case may be required, especially if it is proposed to involve private funding, to help identify the preferred funding mechanism.

Prepare/publish Invitation to Tender (ITT)
Standard procedures should be used to prepare and invite tenders, to evaluate them and select the successful consortium. The steps are:

- **prepare an EU PIN:** i.e. Pre-Information Notice, for publication in the Official Journal of the European Community. This notifies suppliers of a forthcoming Invitation to Tender (ITT) and invites those interested to complete a PQQ (Pre-Qualification Questionnaire);
- **prepare** and publish an **Invitation to Tender** if it is intended to procure the system directly, or an **Invitation to Participate** if a Private Finance Initiative (PFI) is proposed;
- **receive/evaluate the responses** and enter into competitive dialogue if required;
- **select contractor/consortium** and prepare to award contract or, in the case of a PFI, a consortium partner position, but subject to satisfying certain conditions described in the next steps.

Cyberbus system at the new Rome Exhibition Centre, Italy

The new Rome Exhibition Centre is one of the demonstration sites in the EC supported CityMobil project. Here, a Cyberbus scheme is currently being implemented to transport visitors from the car park to the exhibition halls initially, and later, from the train station.

The main proponents of the scheme have been the University of Rome, La Sapienza, with expertise in the required technologies, supported by experts from the city's transport department, and the public transport operating company ATAC. A feasibility study was crucial for obtaining the support of the municipality, but it took many months of further effort to win the support of the politicians.

An invitation for tenders for the supply of six cyberbuses and the necessary control system has been issued.

An Invitation to Tender for a contract to undertake the necessary civil engineering works i.e. preparation, cabling and building the guideway, stops and depot is ready to be issued, subject to no objections from the cultural and historical heritages protection office.

In parallel, work has begun to understand the requirements for certification.

Ready for implementation?	✓
Political support and champion in place	
Feasibility proven	
Approvals required ?	
Public enquiry needed?	
Stakeholder support obtained	
Path to certification established	
Business case decided and means of funding available	

From concept to reality
Implementation

Following selection of the contractor / consortium we can proceed to implementation.

Key aspects at this stage

- Put consortium and funding in place;
- Prepare and apply for necessary approvals;
- Prepare for public enquiry if needed;
- Notify certification body and set up independent quality assurance team;
- Award a contract;
- Build scheme i.e. engineering infrastructure, control and communications system, vehicles;
- Train staff;
- Continue working with media and stakeholder groups;
- Conduct trials and tests;
- Check and solve certification issues.

Cyberbus system at the new Rome Exhibition Centre

Following an invitation for tenders, a contract for six cyberbuses and the necessary control system has been awarded to the Robosoft Company. The first two vehicles have been built and are undergoing tests at the company's test site.

An invitation to tender for a contract to undertake the necessary civil engineering works is to be let when approval is obtained from the cultural and historical heritages protection office.

Work is underway to progress the certification procedure .

Consortium
Decide the funding mechanism and the partners who will be involved in the consortium to build and operate the scheme. If a PFI is to be used, then a special company, and the funding sources, may need to be established for the purpose.

Approvals
For example, Transport Works Act (TWA) order in UK is needed to provide planning permissions and powers to become a transport operator. Similar issues play in other EU countries.

Public Enquiry
A public enquiry may be required to ensure public and political support. Involve the consortium, contractors, and politicians as necessary to prepare for and present at the public enquiry to show the justification and success factors, and also how any barriers and risks will be overcome or mitigated.

Stakeholder network
Undertake additional briefings to prepare the stakeholders and media, and try to enlist their support at the public enquiry.

Requirements for certification
If this is the first GRT (driverless) scheme to be implemented in your country, you must speak to the transport ministry to learn what is required. In most countries, GRT falls under railway regulations*. These require that systems such as GRT with automated vehicles running at less than 40kph are self-certifying. An independent quality assurance team with the necessary expertise will need to be established to secure this self-certification.

* The relevant standard is CENELEC EN50126 Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS).

Following successful outcomes from the public enquiry, and the requirements for certification:

- award the contract: to the successful contractor/consortium;
- build the scheme: there are three main components:
  - the civil engineering infrastructure which includes the guideway, the depot and control centre;
  - the vehicles;
  - the control and communication system.

The construction of all three must be co-ordinated so the component parts can be tested individually before being brought together and tested as a complete system.

- train the operators and staff to ensure good customer relations and the safe and reliable operation of the scheme;
- continue working with media and stakeholder groups as necessary to learn their opinions and overcome problems;
- conduct trials and tests as needed to satisfy requirements and obtain the certification needed to carry passengers.

On the Parkshuttle
Photo: D. Jeffery

Certification

GRT (and PRT i.e. Personal Rapid Transit) systems using automated vehicles have so far been certified for operation in the UK (e.g. ULTra at Heathrow), the Netherlands (e.g. Parkshuttle at Rivium), Sweden (Vectus at Uppsala) and France (various systems at theme parks implemented by Robosoft).

Italy is presently going through the process for the GRT system being installed at the new Rome Exhibition Centre (see box below).

The process is well defined for railways, and has arisen largely from the need to certify automated people movers, i.e. transits, at airports, and the new generation of automated metro systems.

However, there is so far only very limited experience of trying to apply the regulations to schemes in cities. It is expected that the necessary process and procedures will be clarified and documented within the EC supported CityMobil project for the future.

Certification for GRT at Rome Exhibition Centre

The GRT scheme design was delivered to the Ministry of Transport (MoT) in July 2009.

The ministry then asked for railway certification (to EN50126).

Preliminary certification from the MoT that the design is safe is expected in 2010 together with authorisation for on site-trials of a scheme, initially:

- without passengers on board;
- with no intersections between pedestrians, private vehicles and the 'cyberbuses' – i.e. the scheme is to be totally segregated;
- with no intersections between the 'cyberbuses';
- with station doors to meet the requirements defined for the Torino VAL (metro) now under implementation.

The scheme implementers are looking at the certification procedure developed in the EC supported CityMobil project as the means for satisfying EN50126 and securing full certification.

From concept to reality
Operation

Following successful implementation and certification it will be possible to proceed to full operation, although the certification procedure may require that this should take place in stages, e.g. tests without the carrying of passengers in the first place.

Key aspects at this stage

Once full certification is achieved:

- operate and maintain;
- monitor operations and customer relations;
- continue working with media and stakeholder groups;
- evaluate.

Operate and maintain as necessary to provide the required level of service and performance. Extra staff may be needed in the early days to help users familiarise themselves with the new automated system, and so help to ensure customer satisfaction.

Continuous **monitoring** of operations is needed to ensure the system performs as required in terms of factors such as reliability, safety, usability, user satisfaction, etc.

Continue working with **media** and **stakeholder groups** as necessary to learn their opinions and overcome any problems.

Evaluation will be needed in the early days to ensure user needs and the performance specification are fulfilled, and at a later phase to confirm usability and public acceptance as well as the costs and benefits.

Reliability

The application of modern technologies using sensors and on-board diagnostics to provide early warnings of possible problems will ensure that GRT vehicles are robust and operate with very high reliability.

The City Application Manual developed in the CityMobil project is designed to help cities decide whether to consider new technologies and, if so, how best to apply them. A number of tools for cities and operators have been developed to analyse transport requirements and potential impacts. They include a series of context scenarios over the period to 2050, a set of passenger and freight application scenarios which indicate the contexts within which different technologies are most likely to be effective, a tool for predicting patronage for new technologies, a business model for assessing the financial viability of technology projects, a sketch planning model for assessing the overall impact of these technologies in cities, and guidance on how to overcome the key barriers to implementation.

Further information & contacts

Further information

2getthere:
http://www.2getthere.eu/Group_Transit/

Robosoft:
http://www.robosoft.fr/eng/actualite_detail.php?id=1022

CityMobil project:
http://www.citymobil-project.eu/

University of Washington: http://faculty.washington.edu/jbs/itrans/

Morgantown GRT: http://faculty.washington.edu/jbs/itrans/morg.htm

Advanced Transit Association: https://www.advancedtransit.net/

INRIA: http://ec.europa.eu/information_society/activities/esafety/doc/rtd_projects/fact_sheets_fp6/call_4/cybercars_2.pdf

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The mission of NICHES+ is

to build on the success of the first NICHES project by stimulating a wide debate on innovative urban transport and mobility between relevant stakeholders from different sectors and disciplines across the EU and accession countries, in order to promote the most promising new urban transport concepts, initiatives and projects and transfer them from their current "niche" position to a mainstream urban transport application.

This publication is part of a series of 13 publications presenting the NICHES+ outcomes.

A similar set of guidelines for implementers is issued for the topic Personal Rapid Transit

Group vs Personal Rapid Transit ? Both use automated electric vehicles running on segregated guideways to provide an on-demand form of Public Transport, but whereas GRT is collective and typically uses mini-bus sized vehicles that stop to set down and pick up passengers on the way, PRT uses more, smaller (car sized) and faster vehicles to provide a personal service for individuals or small groups, which goes directly to the requested destination stop without making any intermediate stops.

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Further information on NICHES+

www.niches-transport.org
www.osmose-os.org

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