PHILEAS: *The Bus Rapid Transit*

By: Engr. Tan Chee Fai, MIEM, P.Eng.

INTRODUCTION

Cities throughout the world are facing numerous challenges in this new century. They are moving towards increased concentration into megalopolises with more than 100 cities expected to have over 10 million inhabitants over the next 50 years while many smaller ones might face a bleak future if they are not 'connected' to them.

The concentration of large populations in these megalopolises has been made possible by the development of two forms of transportation. The first one was developed in the 19th Century in the form of trains and subways. The second one came from the development of the automobile in two phases. The first phase occurred in the first half of the 20th Century with the development of buses and taxis which provided citizens a new flexibility in their transport not possible with subways and trains, particularly for reaching peripheral locations. The second phase occurred in the second half of the 20th Century with the democratisation of the private automobile and the possibility for every citizen to live outside the city in what became the suburbs.

The automobile has become the dominant transport mode in the world in the last century. In order to meet a continuously growing demand for transport, one solution is to change the control approach for vehicles to full automation, which removes the driver from the control loop to improve efficiency and reduce accidents. Recent work shows that there are several realistic paths towards this deployment: driving assistance on passenger cars, automated commercial vehicles on dedicated infrastructures and cybercars.

Figure 1 shows the PHILEAS bus on the road

BUS RAPID TRANSIT

Bus Rapid Transit (BRT) is a high quality, customer orientated transit that delivers fast, comfortable and low cost urban mobility. BRT systems have some or all of the following elements; many of these can also make a valuable contribution to improving regular bus services.

- Dedicated bus corridors with strong physical separation from other traffic lanes.
- Modern bus stops that are more like bus 'stations', with pre-board ticketing and comfortable waiting facilities.
- Multi-door buses that 'dock' with the bus station to allow rapid boarding and alighting.
- Large, high-capacity, comfortable buses, preferably low-emission.
- Differentiated services such as local and express buses.
- Bus prioritisation at intersections, either as signal priority or physical avoidance (*e.g.* underpasses).
- Coordination with operators of smaller buses and para-transit vehicles to create new feeder services to the bus station.
- Integrated ticketing that allows free transfers, if possible across transit companies and modes (bus, tram, metro).
- Use of GPS or other locator technologies with a central control area that manages bus location at all times and facilitates rapid reaction to problems.
- Real-time information displays on expected bus arrival times.
- Good station access for taxis, pedestrians and cyclists, and adequate storage facilities for bikes.
- Land-use reform to encourage higher densities close to BRT stations.
- Well-designed handicap access, including ability for wheelchair passengers to quickly board buses.
- Excellence in customer service that includes clean, comfortable and safe facilities, updated information and helpful staff.

Compared with regular bus services, BRT offers higher speed, higher frequencies, better information and more comfort. BRT is a concept which covers infrastructure, vehicles, urban design and management.

THE PHILEAS IN THE NETHERLANDS

Although a small country, the Netherlands has always been a pioneer in transportation research because of its key position in Europe as a major entry and exit point. Indeed, Rotterdam is the second largest container terminal in the world, hence, a major gateway for freight transport in Europe. Holland is also famous for its very congested highways due to its large transportation demand and high population density.

In terms of population, Eindhoven is the fifth-largest city in the Netherlands. On 1 January 2005, the city had a population of 208,461 located at 92,464 addresses. At that time, 134,000 people were working in Eindhoven. The Eindhoven region is one of the powerhouses of the Dutch economy and accounts for 14% of the Gross Domestic Product. In fact, 40% of all investments in research & development in the Netherlands are made in the Eindhoven region.

The Dutch government and Advanced Public Transport Solutions (APTS) had developed an articulated hybrid for BRT service between Eindhoven and Veldhoven in 2003. The low floor, articulated vehicle features a Hybrid-Electric Liquid Propane Gas (LPG) drive using electric wheel motors, and a non-contact electromagnetic guidance system developed by FROG Navigation Systems. A set of onboard batteries serve as a second energy source allowing the Phileas to run on electrical power over short distances. Regenerative braking power is used to charge the batteries.

The Phileas is a high quality public transport vehicle which combines the characteristics of the bus, tram and the underground. It is equipped with pneumatic tyres and complies with the statutory regulations for buses. The Phileas may drive on any public roads where buses are allowed to drive. Figure 1 shows the Phileas bus on the road.

The Phileas bus was developed by APTS BV, a consortium of four companies; the Berkhof-Jonckheere Group which produces 1500 buses annually; BOVA which produces 800 coaches annually; SIMAC which operates in the field of information technology, and industrial electronics and automation, and BOM (Brabantse Ontwikkelings Maatschappij), a regional investment company. The Phileas bus uses guidance technology from FROG Navigation Systems in Utrecht, the Netherlands. FROG stands for Free Ranging on Grid.

This system uses dead reckoning based on vehicle kinematics to navigate along a grid of predetermined points. Each point on the grid is associated with an absolute location technology that corrects for the drift in the dead reckoning system. The location technology associated with the grid points can be magnetic markers embedded in the pavement, radio beacon transponders, DGPS, or some other form of accurate local position sensor [1]. Magnetic markers seem to be the currently preferred grid markers. The Phileas is available with a capacity ranging from 48 to 240 people and has a top speed of 70 km/h (43.5 mph). The Phileas claims that only slight modifications to existing infrastructure are necessary to support its guided operation. No rails or overhead cables are required.

The infrastructure requirements for the vehicles are typically:

- dedicated concrete lanes
- 3.2 m (10 ft) wide double lanes
- magnetic markers every 4 m (13 ft) in the road surface
- interfaces with the existing traffic control systems
- adapted pavement height at stops (300 mm or 11.8 inches)

According to APTS, while driving in automatic mode, the Phileas automatically follows a predetermined trajectory; the required lane-width is 3.2 m (9.84 ft) at speeds of up to 70 km/h (43.5 mph). The system performance is based on magnetic plugs in the road surface and works under most weather conditions, even with snow on the road surface. The Phileas also uses multiple steered axles, which provides for tight manoeuvrability even with dual articulated systems. More information on the Phileas can be found at www.apts-phileas.com.

THE ADVANTAGES OF THE PHILEAS

a) Dedicated Infrastructure

To ensure optimum performance and benefits, the Phileas runs on a dedicated route almost throughout its entire length, unhindered by other traffic. The Phileas bus lane is made of 25 cm thick non-reinforced concrete and is 6.6 m wide (for two directions). Concrete was chosen as the building material because it is rigid (non-deformable)–under constant use, asphalt is subject to wheel track rutting–and because the difference in colour (grey instead of black) and structure makes it more readily identifiable. Moreover, concrete has a longer life compared with asphalt and is cheaper. At five places, the Phileas line crosses other roads at grade-separated junctions and so, loses no time. At the other crossings, the Phileas has the right of way or given a priority through the sequence of traffic lights, thus reducing journey times and ensuring a reliable service. The bus way is well integrated into the surrounding area and particular attention has been paid to the green landscaping on either side. Local support and agreement for the required changes to the road infrastructure in existing residential areas was obtained through active local participation in the planning and design work.

b) Comfort

Two versions of the Phileas are in service: a double articulated, 18 m long version with a maximum capacity of 120 passengers and a triple articulated version, 24 m long, with a maximum capacity of 180 passengers. Its special wheel suspension, entirely flat low floor, wide doors and well spaced seating make the Phileas extremely comfortable and easily accessible. The platforms have been constructed on a higher grade, 30 cm above ground level and the same height as the floor of the Phileas vehicles, ensuring easy boarding and alighting without having to step up or down. The gap between the side of the vehicle and the edge of the platform is just 5 cm, presenting no insurmountable barrier for wheelchair access, prams and pushchairs. All the stops, which have a modern design, are fitted with a bus shelter and wooden bench, a line map and departure times, and a pillar with a dynamic passenger information display indicating the waiting times for the various services. The electronic passenger information system enables information such as timetables, departure times and any delays to be obtained via the Internet at home, in shops and in theatres. In the Phileas itself, information is given on the route, the following stop and the arrival time at the terminus.

c) Electronic Guidance

The Phileas is equipped with an electronic guidance system and follows a predetermined route via magnetic markers embedded in the road surface every 4 m. This infrastructure is, therefore, much cheaper than rail and is easy to maintain. The dedicated routes and guidance system greatly reduces the strain on the drivers and ensures a high level of safety, particularly in busy city centres, while allowing the drivers to respond to any unforeseen situation as it occurs.

d) Fast and Reliable

The use of dedicated lanes, grade-separated junctions and priority at grade junctions allows the Phileas to travel at higher speeds, thus reducing journey times. The electronic guidance system enables the Phileas to pull up and stop accurately at the platforms. Along with the large sliding doors and electronic payment system, this keeps stopping times down to a minimum. Journey times are, therefore, considerably shorter than regular bus transport. The journey time from the centre of Eindhoven to Eindhoven Airport and the Veldhoven town centre is less than 20 minutes. In addition to speed and comfort, reliability is another important characteristic of good public transport. The electronic guidance system allows the control room to accurately follow the progress of each vehicle and adjust their speed to fit the timetable accurately. This means that Phileas services are punctual and very frequent: the Phileas operates in both directions every five minutes on both lines.

e) Low-Emission Hybrid Drive

The Phileas has a hybrid drive in which all the wheels, apart from the front wheels, are driven by electric motors. The electrical energy is generated by an economical and environmentally friendly LPG motor that powers a generator with continuous rotational speed. A set of batteries provides secondary power supply. The engine produces more power than necessary; the excess energy and the energy released during braking are fed into the batteries. The Phileas is able to run purely on electric power supplied by these batteries for 3 km. It is also emission free making it ideal for use in the city centre. Because of the hybrid drive and its lightweight construction, the Phileas consumes less energy than conventional vehicles and 25% less energy than a conventional LPG motor. In addition, the materials used in the Phileas are recyclable and environmentally friendly.

f) A Future for BRT

Tackling the problem of traffic congestion and air pollution is not only a matter of designing a transport system or introducing environmentally-friendly technology; it is also a matter of spatial planning and urban design. At the grass roots level, people should be encouraged to use other modes of transport, such as walking, cycling and public mass transit. Building at higher densities around public transport nodes and locating schools, supermarkets and other public facilities and amenities within walking distance should make the use of sustainable transport modes a more obvious choice. All three approaches must be used together to create sustainable and liveable cities.

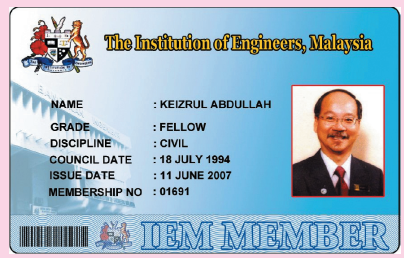
The choice between light rail transit (LRT) and BRT is not just a matter of money and capacity. It also depends on existing and future urban situation, existing transport modes and networks, and political preferences. In most German examples, BRT is not an issue: LRT connects to heavy rail and shares the same infrastructure. Nevertheless, as a concept, BRT seems to have a future. Curitiba, Bogota, Sao Paolo and many other South American cities illustrate that BRT is a cost-effective, efficient and a more environmentally beneficial alternative to LRT.

The introduction of the Phileas in Eindhoven is the first step towards integrated transport and development in the Netherlands. Further steps are necessary to expand the network into a fully operational backbone and feeder structure. Although BRT will contribute to upgrading bus services, in Europe, it will probably never overtake LRT in the transport hierarchy. BRT is a good principle for upgrading feeder services for light and heavy rail, but its flexibility also makes it less permanent: if you take away the vehicles, all that remains is a simple piece of infrastructure. ■

REFERENCES

[1] Wright, L., Bus Rapid Transit: Sustainable Transport: a Source-book for Policy-makers in Developing Cities, ITDP, New York, USA, 2002.

IEM NEW MEMBERSHIP CARD



With effect from 1 January 2008, IEM has been introduced a new IEM membership card for all Members. The new card had been designed to include bar code features as provision for future expansion. It is hoped that this new card would assist IEM to provide better and more efficient service to our Members.

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You may also contact the IEM Secretariat at 603-79684001/2 for an appointment for your photo to be taken.

Thank you for your co-operation.

ERRATA

Y. Bhg. Dato' Engr. Dr Ramli bin Mohamad, the author of the Feature Article appearing in pages 28 to 31 of JURUTERA September 2008 "Precompression of Soft Soils by Surcharge Preloading: Some Common Pitfalls and Misunderstood Fundamentals" has informed that he is not an Associate Professor. The error is regretted.

Thank you.