

Mobility

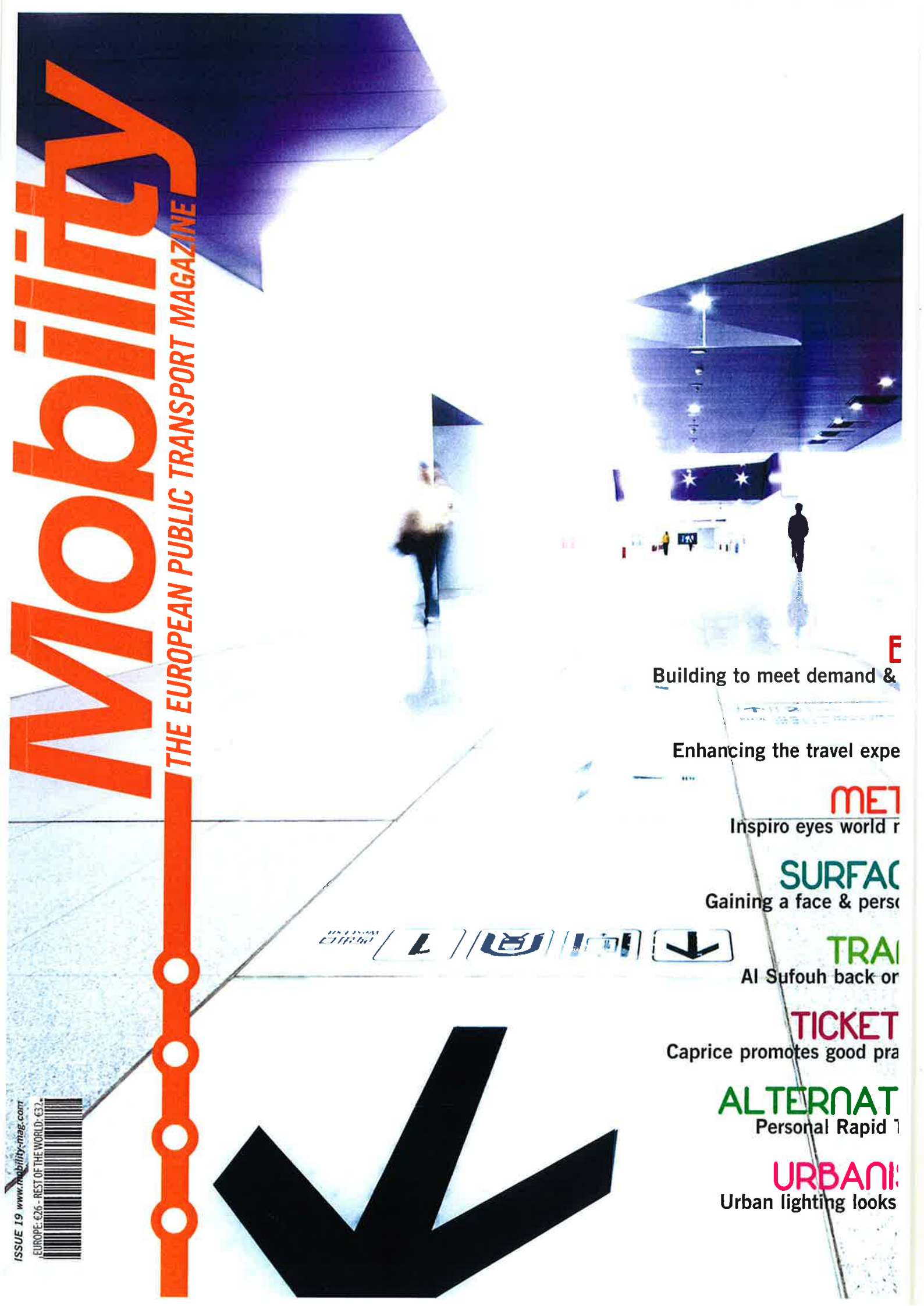
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PERSONAL RAPID TRANSIT - PUBLIC TRANSPORT TAILORED JUST FOR YOU

The world's first public Personal Rapid Transit (PRT) system has been installed at Heathrow airport by ULTra PRT Ltd*. Eighteen four-seater low-energy vehicles guide themselves autonomously around a 3.8km network. Most passengers don't have to wait at all, as the vehicles take them to their desired destination directly and non-stop.



Station in the T5 business car park, Heathrow airport

The trouble with conventional public transport is that it is *mass* transit. To gain economies of scale it gathers passengers together, with little consideration for where exactly they want to go. The result is that passengers must wait at the stop or station until the correct vehicle arrives, wait while it stops en route to drop some passengers off and let others on, and they may have to interchange to another service and wait all over again.

Economies of scale flow from the fact that each vehicle carries the fixed cost of a driver, and possibly other crew. Drivers are expensive, but advances in automation mean that vehicles can safely navigate for themselves. Driverless metros have been

around for a long time now, yet use of conventional infrastructure means that they still carry everyone together in large vehicles. No need: advanced self-navigating vehicles can be small. There is no reason why everyone should travel together. It is clear that people generally prefer the private car, if congestion and parking don't deter them.

Offering an alternative

Personal Rapid Transit offers a public transport service whereby people can travel in automatically guided vehicles the size of a small car, on designated guideways. Passengers travel in these alone or in their own personal group, in the same way as

in a car. Because the system has to have a large number of vehicles to provide the required capacity, and it can guide empty vehicles to any point on the network, there can be empty vehicles waiting in a station when passengers arrive so there is no need to wait, except at the peak of demand. Even then, if there is no empty vehicle waiting one can quickly be called up from a nearby location. Vehicles navigate themselves around the network from any station to any other, and since all stations are off-line there are no intermediate stops or delays. This level of service is way above that of conventional public transport, whether bus, LRT or commuter rail. The concept originated in the 1960s, but although several proto-

type systems were constructed in the 1970s the concept was ahead of the technology, and none were put into service. A system in Morgantown serving the campus of the University of West Virginia came close, but in the end it was redesigned with 12-seater vehicles and intermediate stops rather than as PRT; nevertheless, this driverless system has operated for almost 40 years now without any serious incident. Since then technology and design has moved on, and several PRT systems are becoming commercial realities.

PRT takes to the air

In April 2011 the world's first PRT system opened for business at Heathrow airport. The owners, BAA, decided that PRT offered such large benefits as an airport core trans-



ULTra vehicles on the line-haul part of the network



port system that it was willing to take the risk of becoming the innovator. The system which has just opened is a small concept-proving system, but once it is successfully demonstrated the intention is to expand it to serve the north side of Heathrow, terminals, car parks, hire car centres and possibly hotels.

The system consists of 3.8kms of one-way guideway linking the new Terminal 5 with its business car park. It replaces the existing shuttle bus service and connects just the two locations, so it cannot show the full advantages of PRT as an anywhere-to-anywhere service, but with an operating reliability of 99.7% it is demonstrating the practicality of the concept. The system, provided by ULTra PRT Ltd, of Thornbury in the U.K., uses four-seater battery-powered vehicles, self-navigating on a passive, two-metre wide steel or concrete guideway. Vehicle berths in stations are arranged in a chevron pattern, so that vehicles enter forwards and then reverse out and join the main guideway. Since each vehicle carries its own map of the network and knows how to navigate from one point to any other, its routing is entirely flexible, and choreography in stations, or anywhere else, can be programmed to suit. Once passengers are installed, berth and vehicle doors closed, and the passenger has pressed the 'go' button, the central control system allocates a time slot in a synchronously-controlled vehicle schedule, and the vehicle leaves the station and

travels autonomously to the destination station, navigating junctions as required. At the destination the station control system takes over and guides the vehicle into its berth, where doors open and the passenger alights.

Benefits

This seamless travel is a revelation compared with conventional public transport. Passengers have been surveyed on both PRT and transfer bus. It is clear that passengers much prefer PRT in relation to:

- **waiting time** (average wait time 18 seconds – 5 minutes for bus)
- **image** – this looks like the future
- **environment** (just 0.55MJ per passenger-km, less than a half of that by bus or train, and a quarter of that by car)
- **personal comfort**, and
- **overall experience**

They also preferred it for **safety**, although this difference was small: even so, this instils confidence given the newness of the system and the fact that most of the journey is on elevated guideway. The reduction in waiting time and in-travel delays offers passengers a much quicker journey: in the desk study of PRT applied to the north side of Heathrow, **business passengers would reduce their mean travel time to the Central Terminal Area from 12 minutes by bus to 5.3 minutes by PRT.**

Such a large proportional reduction is unlikely in other applications, but passenger benefits will be very

substantial. Moreover, the zero emissions and low noise of PRT mean that it can be operated inside buildings, and its footprint is no greater than the design strength of an office building.

Infrastructure

A downside of PRT when compared with bus is that it needs segregated track. To avoid severance in an urban environment it is convenient to use elevated guideway for much of the network. However, because the vehicles are so small and lightweight, this allows the elevated structure to be very slim, with the guideway only 0.45m thick. This minimises visual intrusion, and although not a major aspect in the complex environment of an airport, it will be important when PRT is adopted as an urban public transport system.

ULTra PRT Ltd has done a number of detailed case studies in a range of environments, and it has been encouraging to find a great deal of scope for routing guideway through existing developments in an acceptable way. These studies have shown that PRT can offer large passenger benefits, and excellent financial and socio-economic returns, compared with conventional public transport. The lightweight nature of the guideway means that its costs are only a third to a half those of Light Rail Transport (LRT), though vehicle costs are greater because a large fleet is needed. Overall, **30-year NPV benefit cost ratios are around 200% or higher**, and revenue returns can cover amortised capital plus operating costs, whereas new conventional public transport services often struggle to cover operating costs.

In short, PRT offers a qualitatively superior level of service to passen-

ULTRA PERSONAL RAPID TRANSIT – TECHNICAL SPECS*

Vehicle: 3.7m long x 1.5m wide x 1.8m high, 850kg
 Maximum speed: 40km/hr (25mph)
 Maximum payload: 450kg
 Minimum turn radius: 5m
 Maximum climb angle: 20%
 Maximum planned climb angle: 10% (for passenger acceptability)
 Maximum planned decline angle: 6.25%
 Power: 7kW synchronous AC motor
Infrastructure:
 Overall width elevated: 2.1m
 Overall width at-grade: 1.75m
 Elevated guideway depth: 0.45m
 Typical column spacing: 18m
 Typical "long" column spacing: 36m
 Typical column load: 10 tonnes
 Battery charging in stations, or if necessary withdrawal to depot
Safety & security:
 Synchronous time slot scheduling ensures vehicles are separated by the minimum headway of five seconds, while a secondary, track-based detection system equivalent to fixed-block signalling also prevents too close an approach. Automated battery and power train health monitoring guards against unexpected failures, with CCTV monitoring of track. Voice and CCTV communication with central control provides passenger security.
Capacity: the Heathrow system has 18 vehicles operating, giving capacity of 656 seats per hour, but in general PRT will be able to operate at a headway of four seconds or better, giving a guideway capacity of 3,600 seats per hour. Mean occupancy is typically 1.5, suggesting a maximum capacity of 1,350 passengers per hour per guideway.

gers at a very affordable cost. It has long been a dream. Now it is a reality ●

References

*for more information visit www.ultraprt.com or contact Nick Ford at nick.ford@ultraprt.com. The Heathrow PRT scheme is also part of Citymobil an integrated project in the EU's 6th Framework Programme (see BUS, p.30)

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