

**REPORT OF THE
DEPARTMENT OF RAIL AND PUBLIC TRANSPORTATION**

The Viability of Personal Rapid Transit in Virginia: Update

**TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA**



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COMMONWEALTH of VIRGINIA

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December 18, 2008

The Honorable Timothy M. Kaine
Governor of Virginia
Patrick Henry Building, 3rd Floor
1111 East Broad Street
Richmond, Virginia 23219

The Virginia General Assembly
General Assembly Building
Richmond, Virginia 23219

Ladies and Gentlemen:

Attached for your review is the 2009 "The Viability of Personal Rapid Transit in Virginia: Update" that was requested by the 2007 General Assembly session in HJ 603. This report updates information provided in the January 2008 report. This report is provided by the Virginia Department of Rail and Public Transportation on behalf of the Secretary of Transportation, and responds to the General Assembly's direction to:

- i. Study the benefits, costs and overall viability of personal rapid transit as a public transportation option for Virginia.
- ii. Examine, to the extent possible, the current status of the use of personal rapid transit systems in other jurisdictions and consider applications of the technology that would benefit public transportation needs in the Commonwealth.

Sincerely,

A handwritten signature in black ink, appearing to read "Charles M. Badger".

Charles M. Badger
Acting Director

cc: The Honorable Pierce R. Homer, Secretary of Transportation

PREFACE

In February 2007, the Virginia General Assembly passed Joint House Resolution No. 603, “requesting the Secretary of Transportation to study the benefits, costs, and overall viability of Personal Rapid Transit (PRT) as a public transportation option for Virginia.” As directed by the resolution, the Virginia Department of Rail and Public Transportation (DRPT) met with a number of stakeholders to discuss the status and future of PRT and then assisted the Secretary of Transportation with preparing a report in 2007. Similar efforts were undertaken this year to provide the update to the 2007 report.

The 2008 report provides an update on case studies of PRT systems under development and conclusions on the potential application of the technology in Virginia. As noted in the 2007 report, DRPT is not aware of any PRT system that is currently in commercial service worldwide, however, there are two systems that are under construction outside of the United States. If the Commonwealth considers pursuing a PRT application in Virginia, careful consideration should be given to the limitations of the technology, number of available manufacturers and the proprietary nature of certain system components.

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I. Executive Summary

Currently there are no Personal Rapid Transit (PRT) systems in commercial service worldwide; however, two systems are under construction outside of the United States. The first system that is scheduled to operate in mid-2009 is located in Masdar, a city currently being developed in Abu Dhabi, United Arab Emirates. Masdar is being developed with the goal of being the world's first zero-carbon city. As part of this effort, no automobiles will be allowed inside the city; instead they will rely heavily on a PRT system for mobility. The second system under construction is located at Heathrow Airport and is scheduled to open in late 2009. This system will connect a parking facility on airport property to one of the airport terminals. Future expansion of the system is contemplated both on and off of airport property.

With the construction of PRT underway in two locations and several other cities in the world seriously considering the development of PRT systems, it appears that the technology is evolving from concept to reality. While these advances have helped to demonstrate the feasibility of the technology, there are still many challenges that face PRT in terms of large scale deployment such as: technological limitations, a very small number of manufacturers worldwide, and proprietary system components that limit open competition and sustainability. Any application of PRT in the Commonwealth would likely require additional research, development and funding to ensure that the system is sustainable long enough to achieve a return on the investment.

The remainder of this report provides case studies on the latest PRT systems under development and a discussion on the potential application of PRT in Virginia.

II. Background

In February 2007, the legislature of the Commonwealth of Virginia passed Joint House Resolution No. 603, “requesting the Secretary of Transportation to study the benefits, costs, and overall viability of personal rapid transit as a public transportation option for Virginia.” The resulting report, entitled ‘The Viability of Personal Rapid Transit in Virginia,’ was submitted to the Virginia General Assembly in January 2008. The report provided an overview of the concept of personal rapid transit (PRT), including technology requirements; considerations for implementation including ridership and capacity, cost effectiveness, and environmental concerns; case studies of systems previously developed or in development; and conclusions on the potential application of the technology in Virginia.

The report submitted in January 2008 concluded that at the time of writing, no PRT system was in commercial service and analysis by industry experts indicated that additional research and development must be undertaken before such service could be implemented. The report noted that the Commonwealth could choose to take the lead in PRT development by sponsoring additional research or constructing a pilot project, but this would require investment of public resources in research that may not have tangible results in the short or long term. The report further commented that such a risk may not be acceptable to the General Assembly.

The January 2008 report surveyed three systems that had been previously developed or were in development: the StaRRcar system in Morgantown, West Virginia, a Group Rapid Transit system implemented in the 1970s; PRT 2000, a collaboration between Raytheon Corporation and the Chicago Regional Transit Authority, which was under development in the late 1990s but never built; and the ULTra pilot project at Heathrow Airport in London, which was expected to begin revenue service in fall 2009. This report provides an update on the progress of the ULTra system, and also provides an overview of several other PRT systems at various stages of development.

Since January 2008, PRT has moved closer to implementation with the completion of the guideway for the first leg of the ULTra system at Heathrow, and the continued planning for a PRT system that would be the sole form of mechanized transport in Masdar, a new city being constructed in Abu Dhabi, United Arab Emirates. The initial segment of the Masdar system is scheduled to begin operation in mid-2009. The initial segment of the ULTra system is now scheduled to begin service in late 2009.

III. Case Studies

The sections below describe the ULTra and Masdar projects, as well as descriptions of several other systems in development: Skyweb Express, Vectus PRT (currently running on a test track in Sweden), Metropolitan Individual System of Transportation on an Elevated Rail (MISTER), JPods, 2getthere and Hybrid Personal Transit. At the time of this writing, none of the other systems have been chosen for real world application, although interest has been expressed by various cities and organizations.

A. Masdar

Masdar is a city currently being developed in Abu Dhabi, United Arab Emirates with the goal of being the world's first zero-carbon city. As part of this effort, no automobiles will be allowed inside the city. Instead, residents will travel on foot, by bicycle, and by PRT. The first section of the city is scheduled to be completed in mid-2009.

Information on the PRT system being planned for Masdar is limited. What is known is that the system will consist of four passenger vehicles traveling at 25 miles per hour. Wait times are expected to be no more than 1.5 minutes for 50 percent of travelers, and no more than 3 minutes for 90 percent of travelers. In a departure from most PRT concepts, the Masdar vehicles will not travel on elevated guideways. Instead, the guideway will be sunken and pathways for pedestrians, segways, and bicyclists will be located 15 to 20 feet above.

The first PRT vehicles are due in Masdar in summer 2009, indicating that it will be the first PRT system in revenue service and the first to operate on a network rather than a single line. No information is available on the capital or operating and maintenance cost of the system.

Figure 1: Model of the Masdar Vehicle



B. ULTra Pilot Project – Heathrow Airport, London

ULTra (Urban Light Transport) is a PRT technology developed by Advanced Transport Systems Ltd. (ATS). The British Airport Authority (BAA) is working with ATS to construct a pilot ULTra project at Heathrow Airport. The system is planned to replace the current bus service between airport parking lots and terminals. BAA hopes that the new system will not only reduce transit time for passengers, but also help meet its goal of reducing Heathrow Airport carbon dioxide emissions up to 15 percent below 1990 levels. The planned ultimate system will be 22 miles long with over 60 stations, run 47 vehicles, and carry approximately 20,000 passengers per day. Officials expect travel times to decrease by eight minutes, on average. Each ULTra vehicle carries four passengers.

The guideway for the first leg of the system was completed in October 2008. The first leg is expected to open in late 2009. The 2.5 mile track connects the N3 parking deck to Heathrow's newest terminal, Terminal 5 and will use 18 vehicles. It is expected that the average wait for a vehicle will be 12 seconds, with 95 percent of passengers waiting less than 1 minute.

Cost

ULTra technology development has been financed by ATS Ltd., commercial investors, and government entities including the United Kingdom Departments of Transport and Trade and Industry; the UK National Endowment for Science, Technology, and the Arts; and the European Commission. ATS estimates capital construction costs, including vehicles, to be approximately \$30 million, at current exchange rates, for the initial 2.5 mile segment. Operating costs have been estimated at approximately \$1.17 per passenger trip. This operating cost would be 40 percent lower than that of the existing bus service.

Officials of ATS have informed DRPT that costs will be influenced by inflation, current construction commodities markets, and system complexity. Movements in exchange rates have significantly reduced costs and recession-influenced steel and concrete commodities costs are down significantly since January 2008.

Figure 2: Photograph of the ULTra Vehicle and Test Track in Cardiff, Wales



Figure 3: Photograph of the ULTra track at Heathrow Airport



C. Skyweb Express (Taxi 2000)

Taxi 2000 served as the basis for the PRT2000 concept developed by Raytheon in the 1990s and described in the PRT report submitted to the General Assembly in January 2008. When Raytheon decided to abandon the project in 2000, the rights were sold back to the Taxi 2000 Corporation. Taxi 2000 continued to develop the concept, which is now known as Skyweb Express. By early 2007, Taxi 2000 had one prototype vehicle and a 60-foot test track, as well as a scale model with 20 vehicles that demonstrates the control and communication of multiple vehicles operating on a network with multiple stations using the Taxi 2000 proprietary control system. As of February 2007, Taxi 2000 was working to raise capital funds in order to construct a full scale test track with an off-line station and multiple vehicles.

The Skyweb Express system is designed with 3 person vehicles operating on an elevated guideway with 0.5 seconds between vehicles. This would result in a capacity three times the projected capacity of other PRT systems. The control system has been evaluated by Honeywell Aerospace and no conceptual flaws were found. In addition, the scaled working model has shown the capability to operate 20 vehicles on a 2 loop, 3 station track at the equivalent of 40 miles per hour.

In 2007, Taxi 2000 released a feasibility study conducted by Wilbur Smith Associates which evaluated the viability of the Skyweb Express system in an unnamed jurisdiction. This jurisdiction is planned to have a population of approximately 1.8 million residents. According to the report, the Skyweb Express system could be expected to carry 84,000 trips per peak period, which would represent 27 percent of the municipality's transit ridership.

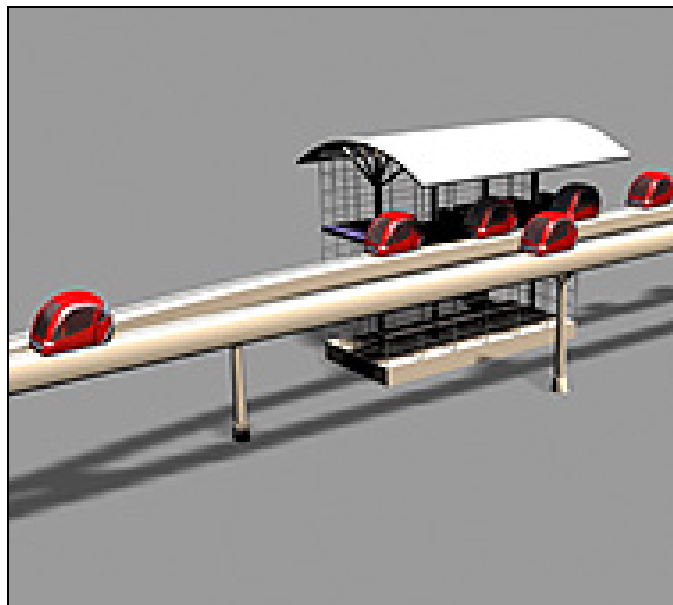
Cost

Cost estimates were developed for the 2007 feasibility study. It should be noted that the study did not include any preliminary design, and so costs were developed with an accuracy of +/- 20 percent. Capital costs for the feasibility study were estimated at \$31.5 million per mile. Operating and maintenance costs were estimates at \$0.70 to \$0.90 per passenger trip.

Figure 3: Skyweb Express Vehicle



Figure 4: Concept Showing Skyweb Express Vehicles Passing a Station



D. Vectus PRT

Vectus was formed in 2005 by POSCO, a Korean steel company, and is currently testing its technology on a 1,300 foot test track in Uppsala, Sweden. Testing began in mid 2007 and the system received safety approval from the Swedish rail authority, also in 2007. The Vectus system consists of four-passenger cars operating on an “ultra light” modularized steel guideway. The system is projected to carry 4,800 to 5,760 passengers per peak hour and peak direction at approximately 40 miles per hour with 2.5 second headways. Stations would be placed every 1,000 to 1,600 feet, and no passenger would wait longer than 1 minute during periods of peak demand.

The Vectus system has garnered worldwide interest and has performed successfully on the test track in Uppsala. The test track has been visited by local officials from around the world who are interested in the technology, however, the first system is yet to be placed under contract.

Figure 5: A Vectus Vehicle on the Test Track in Uppsala, Sweden



Figure 6: Vectus Vehicles at the Test Track in Uppsala, Sweden



E. Other Systems

A number of other companies have developed PRT systems, but have not constructed test tracks. These include MISTER, from Poland, JPods, based in Minnesota, 2getthere, based in the Netherlands, and Hybrid Personal Transit, based in Virginia. Below is a short description of these systems.

Metropolitan Individual System of Transportation on an Elevated Rail (MISTER)

The MISTER system would consist of one to five passenger vehicles suspended from an overhead guideway 33 feet above grade. The average traveling speed would be 30 miles per hour and the system would have a peak capacity of 3,000 vehicles per hour per direction, which translates to between 3,000 and 12,000 passengers. Capital costs have been estimated at \$12.6 million per mile, which would cover the construction of the guideway, six stops, one hundred vehicles, and mechanical systems. A prototype of the MISTER vehicle was displayed in Opole, Poland in September 2007. In July 2007, the Opole mayor and city council signed letters of interest indicating their willingness to develop a system in the city with 21 miles of track.

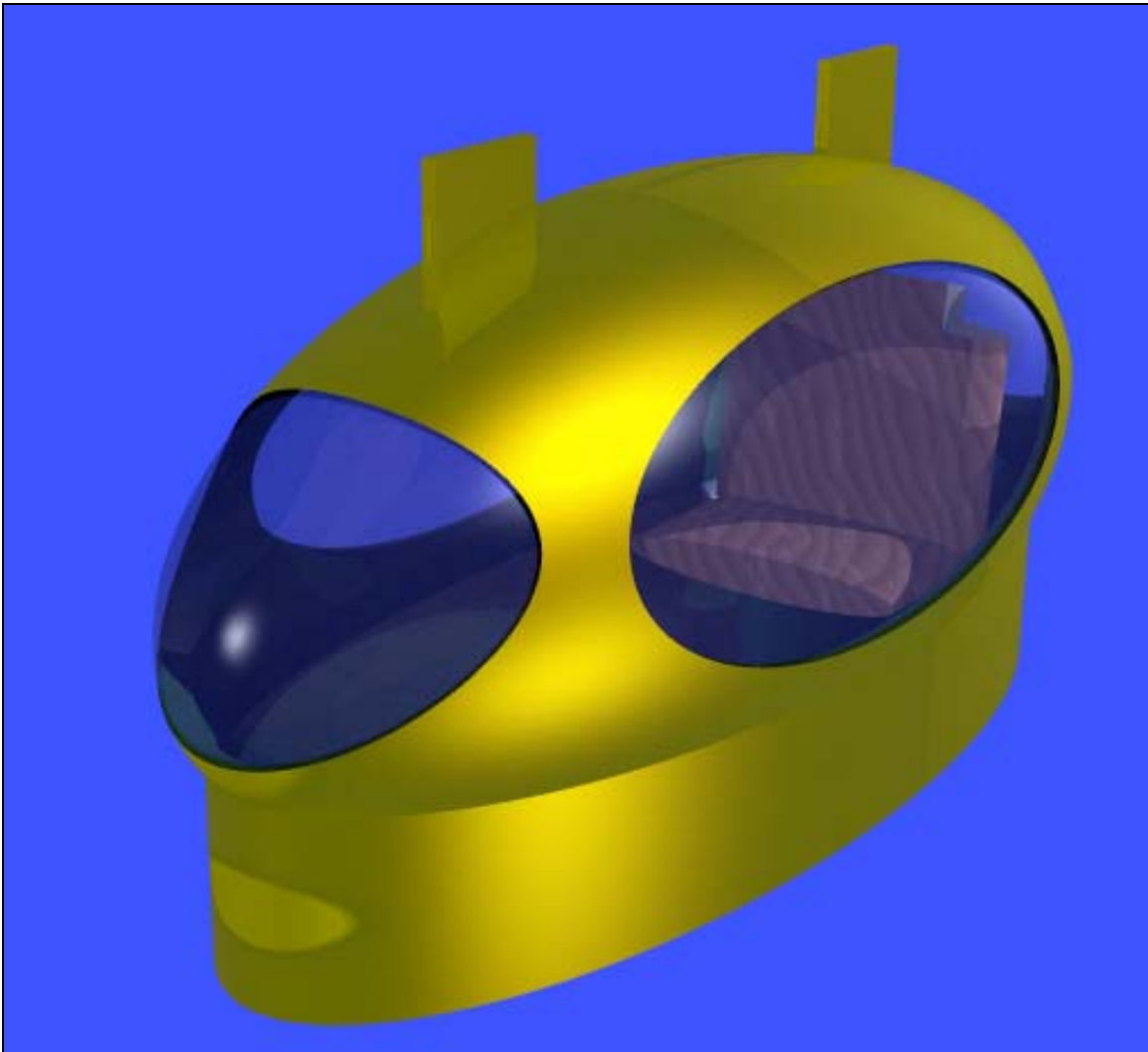
Figure 7: MISTER Prototype on Display in Opole, Poland, September 2007



JPods

The JPods system consists of vehicles of varying sizes suspended below the elevated guideway and capable of traveling up to 30 to 40 miles per hour. Typically the vehicles would seat one to four people, with room for groceries and small items. Some would have room for two bicycles, and others would be configured to transport larger loads. The system would be capable of operating on solar power. Letters of interest in the JPods system have been signed by the Water Park of America (Bloomington, MN), the City of Richfield, MN, and the Mall of America (Bloomington, MN).

Figure 8: A JPOD Vehicle Option



2getthere

The 2getthere Company markets and develops Automated People Mover Systems for personal and group transportation. The conceptual system features automated taxis (CyberCabs) and a supervisory control system known as *TOMS* (Transit Operations Monitoring and Supervision). The guideway can be constructed at grade, but also elevated, embedded in buildings or underground. The system can be configured to provide direct connections, on-demand operations and personal transportation. CyberCabs can also be shared if people want to use one cab but travel to multiple destinations. The company reports that second level engineering on the system is complete. No information is currently available on potential capital and operating and maintenance costs.

Hybrid Personal Transit

A companion to personal rapid transit is a concept called hybrid personal transit (HPT). The system would allow properly equipped, personally owned, highway vehicles to access a system of elevated fixed guideways (called "Grids"), and run electrically from power supplied from the Grids. After exiting at a chosen point, Grid vehicles would travel onto their destinations using ordinary roadways. The Grid structure itself, would be an "I" beam set atop concrete columns and Hybrid Personal Transit vehicles would encompass the top section of the beam. This system would make use of the control technologies which allow PRT to handle many vehicles traveling close together at high speeds without collision. Hybrid PRT, Inc., is a Virginia Corporation that is seeking to conduct design, testing and initial implementation in the Commonwealth. Hybrid PRT has applied for a U.S. Patent for the System as well as patents in several foreign countries. Hybrid PRT is not pursuing state funding but has indicated that it is seeking access to state right-of-way in interstate corridors to implement the system.

IV. Conclusion

Interest and development of PRT appears to be growing around the world. With the inevitable construction of at least two systems and the testing underway of several others (although in most cases not at full scale), it can be argued that PRT is proving to be a feasible technology. The future of PRT, as with any other new technology, will require time to mature meaning that standards need to be developed, manufacturers and suppliers need to be put in place, and appropriate applications of the technology need to be considered. For the Commonwealth, the decision to pursue the implementation of PRT also depends largely upon funding availability.

The next step for PRT in Virginia is to determine if the Commonwealth is willing to provide funding, and/or attempt to pursue federal funding, for planning, research and development activities to better understand the costs and benefits of PRT. Public-private partnership opportunities or partnerships with universities may be other possible opportunities. In terms of a location in the Commonwealth to conduct a pilot program, the Secretary of Transportation was provided in January 2008, with the consent of the House Transportation Committee, a proposed resolution for consideration requesting that Portsmouth be considered as one of the potential cities to conduct a pilot program. If a program is developed, other localities should also be made aware of the opportunity to participate.

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