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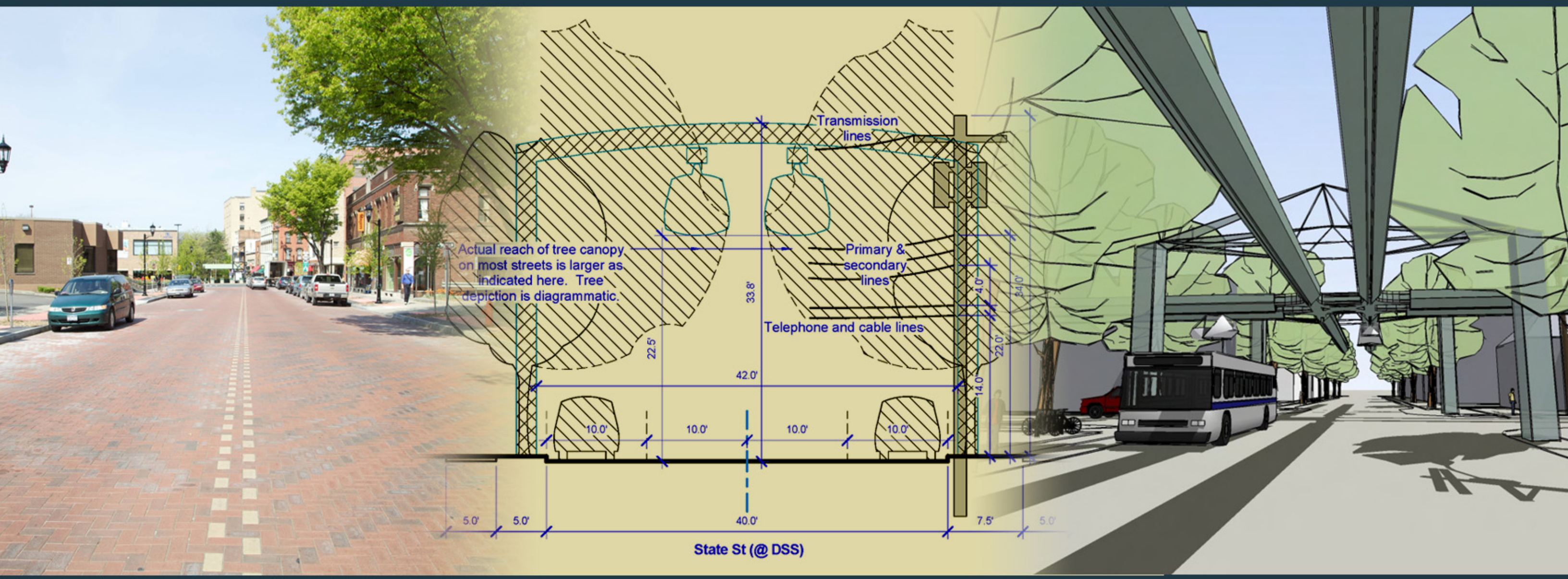

Feasibility of PRT in Ithaca, New York

Executive Summary

September 2010

C&S COMPANIES®

CONNECT ITHACA LLC

FEASIBILITY OF
PERSONAL RAPID TRANSIT IN ITHACA, NEW YORK
Executive Summary

Prepared for

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SUMMARY

Personal Rapid Transit (PRT) is an emerging technology that has the potential to reduce the emission of greenhouse gases and the consumption of petroleum products by reducing vehicle miles traveled (VMT). This research study funded by the New York State Energy Research and Development Authority (NYSERDA) and the New York State Department of Transportation (NYSDOT) evaluates the feasibility of implementing a PRT system and policies to promote transit oriented development (TOD) in Ithaca, NY. The study assesses how the PRT system together with TOD will enhance the quality of life and promote economic development in New York's small and mid-sized cities.

PRT (also known as *PodCar*) is a subset of a type of mechanized public transportation system known as an Automated Transportation System (ATS), Automated Group Transit (AGT), or Automated People Mover (APM). PRT has the following features that differentiate it from APMs and other forms of traditional transit:

1. 24-hour on demand service
2. Non-stop direct service
3. Fully automated vehicles
4. Small vehicles: one (1) to six (6) passengers
5. Small dedicated guideway

PRT Development

Even though some of the key concepts of PRT have been tinkered with for over a century, contemporary PRT discourse did not really begin until around 1953 when Donn Fichter, an American planner now retired from the NYSDOT, first sketched out a PRT system he called Veyar. Early PRT system development and implementation took place in the late 1960s through the 1970s. It was during this period that the Urban Mass Transportation Administration (UMTA) contracted with NASA's Jet Propulsion Laboratory to develop the Morgantown Personal Rapid Transit project, the first automated people mover in the U.S. at the University of West Virginia. The system is still in continuous operation with about 15,000 riders per day (as of 2003). Several other systems were also developed and tested in Europe and Asia. However, in the early 1980s there appears to have been a loss of interest in PRT. The General Accounting Office issued a report entitled *Better Justification Needed for Automated People Mover Demonstration Projects* and Congress withdrew support for the development program of automated transportation systems with three-second headways. Recent advances in PRT technology and the eminent commercial operation of a PRT system at London's Heathrow Airport and Masdar City, Abu Dhabi, have generated renewed interest and promotion of PRT.

While there are fourteen different systems in various stages of research, design, testing and implementation, only three systems are currently commercially viable.

1. BAA/ULTra : Bristol, United Kingdom, EU - The first modern PRT system is in place at London's Heathrow Airport. The system is carrying employees and is slated for full passenger service in the fall of 2010.
2. 2getthere: Ut recht, Netherlands, EU – Masd ar C ity in United Arab Emirates (UAE) is being designed with a su bterranean PR T sy stem. The sy stem pr ovider, 2getthere, i s undergoing operational testing and is expected to provide public service in late 2010.
3. VECTUS, LTD: Uppsala, Sweden and Seoul, Korea - VECTUS, a UK registered company, with branch offices in Korea and Sweden received passenger safety certification from the Swedish Rail Authority in early 2009 and is scheduled to deploy a PRT system in Suncheon, South Korea in 2013.

Description of PRT

Among PRT systems that are being implemented and planned, there is substantial diversity in the approach to design. This study reviews the following system components and characteristics:

System Components

1. Guideway

A primary system component is the dedicated guideway which can be at-grade, elevated or underground. The guideway is structured as a network, unlike the line haul system of traditional transit. The network configuration allows vehicles to select the most direct route between stations.

PRT guideways are smaller than traditional transit requiring less right-of-way and capital expenditure and reducing visual impacts. PRT guideways are generally classified as one of the following:

- *Open guideway* –The system consist of a flat surface that supports the vehicle. Vehicles typically have rubber wheels and steer themselves, sensing their position relative to side walls or other fixed objects.
- *Captive bogey.* In this system, the vehicle is supported by the chassis it rides on. The vehicles typically have horizontal wheels that run along and are held captive by side elements. The guideway steers the vehicle.
- *Suspended.* Vehicles in this system are suspended (hang) from the guideway.

2. Vehicle

The vehicle design is dependent on guideway type and will vary by vendor. The optimum vehicle size is in the range of two to six passengers to provide convenient, demand-based service with maximized energy efficiency.

3. Propulsion

The PRT industry has primarily worked with electric propulsion, although some have a gas powered option. Within electric propulsion there are two concepts to consider – power source and propulsion method. Power source can be provided by batteries within vehicles or a lineside conductor (power rail). The propulsion method is typically provided by traditional rotary motors that drive wheels or linear electric motors that propel the vehicle via electromagnetic resistance.

4. Switching

There are two general types of switching used in transportation systems- mechanical and electromagnetic. Mechanical systems require a moving physical component, while electromagnetic methods simply guide the vehicle via magnetic attraction and no moving parts. Mechanical switching is typically a vehicle-mounted mechanism that deploys well in advance of the diverging point on the guideway and maintains control specific to each vehicle. In the event that a vehicle-mounted mechanical switch fails the problem is isolated to the vehicle. The use of electromagnetic switching is becoming more popular as the PRT technology has matured. Some systems place the switch in the guideway but like mechanical switches, a vehicle mounted switch is preferable to avoid a system wide shutdown in the event of a switch failure.

5. Stations

A primary feature of PRT stations is that they are situated on off-line side tracks so that through-traffic can bypass vehicles picking up or dropping off passengers. This allows the system to provide direct, non-stop service to each vehicle. Unlike traditional heavy and light rail stations that need to accommodate the full length of the train, PRT stations are sized to meet the local demand at peak times.

6. Maintenance and Storage Facilities

A depot is needed to service vehicles to maintain reliability, clean vehicles, and store vehicles not used during off-peak periods. Depending on the overall configuration of the PRT system the number and dispersion of depots will vary. In general it seems practical to locate depots at the periphery of urban areas where the necessary land acquisitions is more feasible or place them in areas of high demand such as near a collegiate sporting arena.

System Characteristics

1. Headway

Headways refer to the spacing between vehicles and can be defined in terms of time or distance. From a safety standpoint headways are usually determined by the stopping distance required to prevent a lead vehicle that is stopped from being struck by the vehicle behind it. The spacing of pods on the guide-way influences the overall maximum passenger capacity of the entire network, so designers prefer to achieve smaller headway distances. Testing has shown that headways of one to two seconds are achievable. One system, VECTUS, has obtained safety approvals to operate at 3 seconds headways.

2. Travel Speed

PRT systems have been simulated to operate with a line speed in the range of 25 to 45 MPH, which often results in an average speed of 20 to 25 MPH. These simulations factor in the impacts of system congestion on switches and potential reduced speeds under times of heavy system loads. In comparison buses average 12 MPH and light rail averages 15 MPH.

3. Capacity

PRT systems vary their capacity by increasing the number of vehicles or pods in the system and reducing the headways between vehicles. Studies have estimated that the capacity of a PRT system can range from a capacity similar to the auto (1,800 passengers per hour) to a capacity comparable to light or commuter rail (14,400 passengers per hour).

Application of PRT in Ithaca

The City of Ithaca was selected as a case study to assess the feasibility of implementing a PRT system in New York. The city's population is 29,287 and the greater metropolitan area has a population of 100,135. The total number of jobs within Tompkins County, where Ithaca is located, is 57,032. The City is also home to two major college campuses: Cornell University and Ithaca College. These demographics are consistent with areas that have a growing demand for transit and where PRT is stated to be the most efficient. Several recent local studies have also documented the need for improved transit service and the desire to have increased development density that would rely on alternative transportation modes. The study documents the various considerations for implementation of PRT in Ithaca, NY.

Research and Data Collection

Existing relevant studies were compiled and reviewed to obtain background transportation and travel behavior information. Fully 40 percent of Tompkins County commuters currently use alternative modes of transportation, compared to only 25 percent nationwide. Several studies document the region's continued support of transit and increased density in urban areas and the Ithaca-Tompkins County Transportation Council Long Range Plan suggests that PRT as a transit option is worth further investigation.

Route Prioritization

A full PRT system for Ithaca would include an extensive network connecting West Hill, South Hill and East Hill/Cayuga Heights; serving as a circulator route between downtown and the major educational institutions, as a connector between park and ride facilities and these major employment centers and provide access to retail and medical facilities on the city's perimeter. However, the extent of the PRT system is limited by the funding for this study and therefore focuses on a Phase 1 section that will link Cornell University, Downtown and Ithaca College. These three destinations were selected because they offer the highest density of workplaces in the county, have a broad mix of uses, and have a significant amount of existing housing within a five-minute walk of the proposed system. In addition to serving the three major destinations, the following considerations were taken into account in the assessment of route prioritization:

1. The area served by the route must have sufficient capacity to support new mixed-use, transit-oriented development (TOD).
2. The route must provide access to storage parking location(s) to insure the near term market viability of new housing development, and ease existing parking problems in neighborhoods surrounding developed or developing areas like Collegetown.
3. The route must extend to or include a location suitable for a maintenance and operations facility (likely including pod storage tracks).

Another consideration in the development of the preferred route is the use of single versus double track configurations. PRT is best organized in looping configurations where a single track carries vehicles running in one direction along one street, and another single track carries traffic in the opposite direction on another street. This distributes the PRT service, allowing for the location of stations over a larger service area. It also distributes the infrastructure over a greater area, impacting more locations but with a smaller sky-print at each location. Double track, with both travel directions supported on one set of poles along a single street, concentrates the infrastructure impacts in one location; however, the sky-print of double track is greater than for single. Route prioritization minimizes the use of double track configurations. The proposed route is depicted in the following figure and summarized below:

Guideway Length: *Total equivalent double track length – 4.5 miles*

Single track – 4 miles/Double track – 2 miles/Station associated track – 1 mile

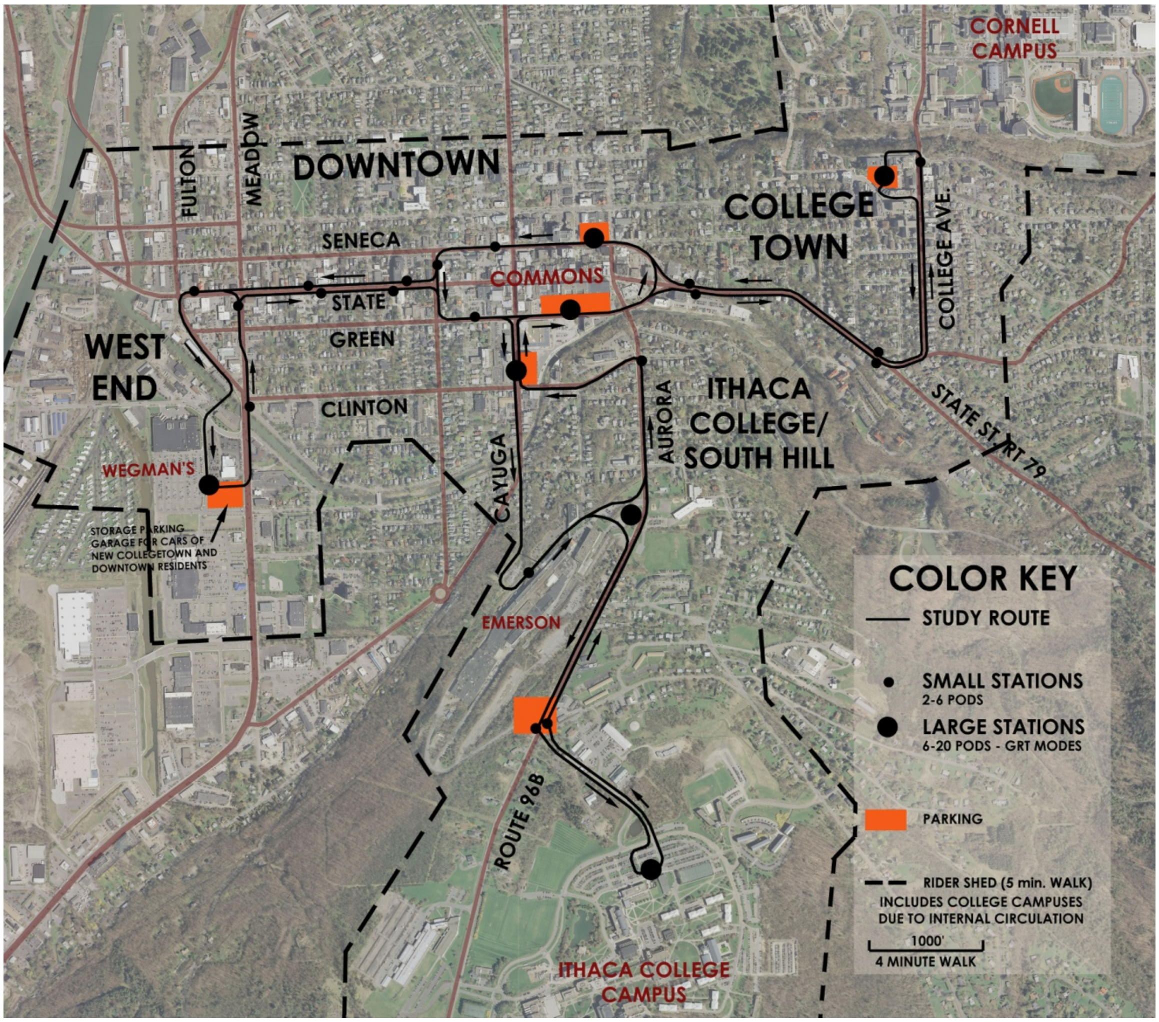
Total equivalent single track length – 9 miles

Stations: *26 Total Stations*

7 Large stations (4 berths each)/19 Small stations (2 berths each)

Vehicles: *350*

Storage Depots: *Total capacity for 500 vehicles* (provided in two facilities)



Proposed Route

Technical Feasibility

Optimum technical characteristics of a PRT system operating in Ithaca, New York were developed based on the scale and character of the existing built environment, the Upstate NY climate, and Ithaca's challenging topography. One of the largest factors regarding physical integration of a PRT system into an existing urban streetscape is the utility infrastructure. Not only would the guideway have to be kept above standard road clearance heights, but also it would have to negotiate the telephone, communication, and power lines that cross the right-of-ways (ROWs). The concept of integrating these utility lines into the PRT infrastructure is interesting and provocative but may be politically and fiscally difficult. Therefore, this study assumes that the PRT system will share the ROW with the existing utility line infrastructure. With the above factors in mind, the following system characteristics have been identified:

- Minimum turning radius must be 50' (15m) or less to keep track within public rights of way.
- System must exhibit quieter than automobile operation (<65db) because of inevitable proximity to buildings.
- System selected must have enough design flexibility to allow for track to be positioned over the center of streets, above the touching point of the tree canopy, so as to hide the infrastructure from the pedestrian level and to minimize impingement of natural tree shapes.
- Track underside should not exceed 24" (0.6m) to minimize the visual impacts of overhead tracks, especially where dual direction lines are located.
- Support pole spacing should be equal to or exceed utility pole spacing (60' – 80' average).
- Edge to edge visual intrusion of support structures must be minimal. (<24" dia.).
- In most areas opposing support poles would ideally be placed on the sides of the road, typically within the tree lawns, and connected with cross-beams to support the guideways running over the center of the streets.

Preferred Guideway for Ithaca System - Although this is an area that will require additional research, based on currently available data the preferred system for Ithaca, NY would include an elevated guideway with either a captive or suspended bogey.

Vehicle - A critical factor of the physical vehicle design in a PRT system is size. One of the differentiating factors that separate PRT from other transit modes is the small vehicle size and number of passengers. The optimum vehicle size is in the range of two to six passengers to provide convenient, demand-based service with maximized energy efficiency. The most notable difference between the vehicle concepts that currently exist is seat orientation. The vehicle side and seating orientation would be determined during the design of a system. Other considerations for vehicle design are the suspension and braking systems which will depend of the type of guideway and propulsion systems used.

Propulsion - Linear Induction Motor (LIM) driven systems appear to be the logical choice for smaller PRT networks that do not require high speeds. Ultimately the propulsion choice for a PRT system will have long term impacts in terms of energy efficiency, serviceability, and continued viability.

Policymakers will want to make the most effective choice with the inevitable public funding that will support PRT implementation, so additional study of this topic is recommended.

Switching - The clear advantages of magnetic switching over mechanical systems are speed, reliability (even more so with redundancy), less susceptibility to weather, and logical integration with propulsion systems using linear electric motors. The decision on the type of switching to utilize will fall on the manufacturers of the preferred PRT system and would ideally have the ability to upgrade or transition from one switching type to another. In vehicle switching is preferred for system reliability and maintenance.

Stations - A key characteristic of PRT is the off-line station configuration that allows for all trips to be non-stop from origin to destination by bypassing intermediate stations. Because of the above grade design a logical place for station locations is over small parking lots since the current land use would be minimally affected. Another location for easy and logical station locations is adjacent to large “big box” retailers where parking facilities and space are ample, the locations are typically peripheral to urban core areas and thus make good park-n-ride locations, and the environmental impacts of surface parking and predominant automobile access can be relieved by PRT trips. Within the urban core a logical placement of stations is to build them into parking garages since this provides parking as well as long building facades for the platforms. Since stations will be on private property, additional research and coordination with property owners is required to assess their willingness to cooperate and the feasibility of using existing structures.

Maintenance and Storage Facility - The maintenance of a transportation system plays a significant role in the long term viability of a system. To provide adequate space for service bays, cleaning and vehicle storage, it is anticipated that two 250 berth storage depots would be required, each with a building footprint of approximately 165’ x 140’ with two upper storage floors for a total square footage of 51,100 SF. Above the larger first story footprint would be ample space to construct offices and a system control center.

Headway - Headway is defined as the time or distance between moving vehicles. Headways of 3 to 5 seconds would provide an acceptable level of service in Ithaca.

Travel Speed - PRT systems have been simulated to operate with a line speed in the range of 25 to 40 mph, which often results in an average speed of 20 to 25 mph. These simulations factor in the impacts of system congestion on switches and potential reduced speeds under times of heavy system loads.

Capacity - In an effort to understand the impacts and performance of an initial Ithaca PRT system some simulations were performed utilizing Beamways' proprietary software BeamEd, which documented the feasibility of a design hour volume of approximately 3,000. This is consistent with the ridership projection assuming no new transit oriented development. If additional development were to occur along the PRT system, the system would need to add vehicles and/or be expanded into a network configuration.

Right-of-Way Assessment

A series of assumptions were developed to assess the potential ROW requirements for a PRT system in Ithaca. The majority of the system will be placed within the existing road ROW, owned by the City of Ithaca or State of New York. In some sections, curb extensions will be required to accommodate the poles. This will result in some loss of parking that would be determined during the design phase. The locations where the PRT system deviates beyond the existing public ROW are near the Collegetown station, Wegman's station and the Ithaca College station. It is anticipated easements will be required for seven tax parcels to accommodate track infrastructure.

Large stations identified in the study route are proposed to be integrated into existing parking garages. It is assumed that the larger stations utilize stairs and elevators in the existing parking garages. The Dryden Road Garage and Green Street Garage stations are planned to be on the roof of the garages. The height of the Seneca Street and Cayuga Street garages (8 stories), places the stations at the 3rd or 4th parking levels. The large station at Wegman's would be built into the storage parking garage, integrated with the building. New structures will need to be built in the Ithaca College and the manufacturing parcel to the west of Aurora St. A private negotiation with seven property/facility owner is necessary to determine the value of individual easements and acquisitions. These negotiations will also need to address the following issues:

- Access to privately-owned parking garages need to be obtained,
- The potential loss of parking needs to be addressed, and
- The structural feasibility of the overhanging station platforms need to be analyzed.

Several small stations are also planned along the PRT system. Fifteen tax parcels will be impacted by the construction of small stations.

Constructability Assessment

The construction of an elevated PRT system is comparable to an elevated light rail system although the low weight of small pods allows smaller guide-ways and support structures than light-rail. These smaller structures translate into lower construction cost and smaller easements. The primary issues associated with construction are associated with the construction of a new system in an already constrained urban environment. Key issues include site logistics and constraints:

- Maintain access to adjacent buildings,
- Utility clearances and potential relocation,
- Maintenance and protection of traffic,
- Potential disruption of the groundwater,
- Potential impacts to adjacent buildings,
- Crossing of six-mile creek, and
- Use of existing structures for stations.

Assessment of Transit Oriented Development

An analysis was conducted to determine the potential for transit oriented or transit supportive development (TOD or TSD) within the area served by the proposed PRT Phase 1 Route. The area within a 5-minute walk of the system contains approximately 10,400 residents and 300 to 400 businesses. With the inclusion of the 26,000 students and 11,000 workers at the college campuses, the proposed system area would likely provide the minimum population density, job concentration and destination characteristics necessary for viability as determined by the 2007 study *Viability of Personal Rapid Transit in New Jersey.* This suggests that density is not required to implement PRT. However, the development of a PRT system will provide the opportunity for additional higher density development with reduced on-site parking requirements thereby reducing vehicle miles traveled and associated greenhouse gas emissions. TOD will also support increased PRT system ridership providing financial support for operation and maintenance activities.

Four development scenarios were generated for comparison of land use and ridership forecasts:

- Scenario 1: Theoretical development potential per current zoning.
- Scenario 2: Actual development potential tempered by market demands for parking.
- Scenario 3: Development potential per current zoning with PRT.
- Scenario 4: Development potential of expanded zoning envelope.

Ridership Forecast

Ridership for the PRT system in Ithaca is assumed to occur from the following scenarios:

1. Shift from the existing Tompkins Consolidated Area Transit (TCAT) bus service
2. New demand resulting from shift in mode share
3. New demand from transit oriented development
4. New demand from proposed Park and Ride service

Ridership forecasts were developed for the four development scenarios. The base ridership without any TOD that includes the displacement from TCAT service, shift in mode share and proposed Park & Ride Service is first estimated. To highlight the importance of TOD to the total ridership, TOD scenarios 3 and 4 are added respectively to the base ridership.

PRT Ridership Sources	**DHV**	**Weekday Daily**	**Weekend Daily**	**Annual**
Total Ridership without TOD	3,110	12,660	4,160	3,734,500
Total Ridership - TOD Scenario 3	4,190	23,720	13,860	7,629,600
Total Ridership - TOD Scenario 4 5	,790	40,550	28,460	13,540,000

In comparison, the average daily ridership for Morgantown GRT in 1995 was 14,000 with a record daily ridership of 30,175. The anticipated base ridership for Ithaca PRT (12,660) is close to the average daily ridership of Morgantown PRT. TOD Scenario 3 that has the development potential per current zoning with PRT brings the Ithaca PRT ridership (23,720) closer to the record Morgantown ridership. TOD Scenario 4 which includes the development potential of expanded zoning envelope makes the Ithaca PRT ridership exceed the Morgantown PRT record ridership.

Approval Requirements

The following approvals will be required to construct and operate a PRT system in Ithaca, New York.

- Federal – If federal money is used the project will need to go through the Metropolitan Transportation Planning Process, comply with the National Environmental Policy Act (NEPA) and be sponsored by a public entity.
- State – The development of the system will require:
  - approval from the New York State Department of Transportation (NYSDOT),
  - compliance with 6 NYCRR Part 617 State Environmental Quality Review (SEQR),
  - compliance with terms and conditions of a NYSDOT Highway Work Permit, in accordance with New York State Highway Law, Article 3, Section 52,
  - operating authority through the New York State Department of Transportation (NYSDOT) NYSDOT Registrating and Permitting Bureau,
  - development of a System Safety Program Plan (SSPP) approved by New York's Public Transportation Safety Board (PTSB),
- Regional - To receive federal funding, the development of a PRT system needs to receive approval from the Ithaca-Tompkins County Transportation Council (ITCTC) and be incorporated into the Transportation Long Range Plan and ultimately the Transportation Improvement Program (TIP)
- Local – The City of Ithaca would need to approve the development of a PRT system and transit-oriented development. If approved the following additional approvals and actions would be required by the City of Ithaca:

- amendment to the City Zoning Code for transit-oriented/supportive development,
    - sub-division approval and site plan review through the City of Ithaca Planning and Development,
    - building permits through the City of Ithaca Building Department,
    - easements within the city owned road right-of-way and street permits through the City of Ithaca Department of Public Works.
- Other – The design and construction of the system may require relocation of some existing utilities that would require coordination and approval with individual companies. It is recommended that the PRT system comply with the voluntary standards established by the American Society of Civil Engineers (ASCE).

Capital and O&M Costs

Development of capital and operation and maintenance costs were developed based on data provided by seven PRT vendors who responded to a request for information (RFI). The following is a summary of the estimated capital costs per mile of double track:

Guideway & infrastructure:		$15 million per mile
Vehicles:	$3	-6 million per mile
Stations:	$4	million per mile
Storage and Maintenance Facilities:		$4 million per mile
Total:	$	26-29 M per mile

The Study Route is the equivalent of approximately 5.75 miles of double track so the total infrastructure cost of a PRT system similar to the Ithaca Study Route would be $150 to $168 million. It is anticipated that design will be 16% of the capital costs, adding $24-27 million. With the additional $1.5 million anticipated for ROW acquisition, the total estimated capital cost of a PRT system in Ithaca that can be used for planning purposes is $175 to $196 million. Based on the average of this cost range, $186 million, the per mile cost for a PRT system in Ithaca can be estimated at $32 million per mile of two-way track. This is consistent with estimates by Booz Allen Hamilton, in the Viability of Personal Rapid Transit in New Jersey Final Report, which indicated the capital cost of two-way PRT track ranges from $30-$50 million per mile.

Due to the many variables associated with the design of a region specific PRT system, the ability to forecast precise operating and maintenance (O&M) costs is too difficult at this time. Using the data provided by vendors and incorporating a 20% contingency factor, operating and maintenance costs are estimated to be approximately $1 million per year per mile or $5.75 million annually.

Additional costs are anticipated to address the need to relocate utilities, modify the tree canopy and potentially provide visual screening of the PRT system or refinement of the aesthetics to blend the system with the neighborhood character. Additional research will be required to fully understand the impact of these costs.

Financing

The vast majority of surface transportation funding in the U.S. is derived from public sources at the federal, state, and local levels. Additional funding may be available through private resources. The study identifies potential funding sources at the time of report preparation and is subject to change. As traditional sources of transportation revenue continue to decline in adequacy to fund transportation systems, new funding mechanisms will necessarily be implemented to meet the increasing demands on paying for future system operations, maintenance, and expansion.

Project Benefits

Energy and Environmental Benefits

Due to the inherent efficiencies of the extremely light-weight vehicles and non-stop travel, the energy use for PRT is generally more efficient than other modes of transit. The proposed Ithaca PRT Study route has the potential to reduce annual vehicle miles traveled (VMT) by 3,054,100 miles resulting in a reduction of 1,694 metric tons of CO_2e. Additional transit-oriented development (TOD), supported by the PRT system, could further reduce VMT and greenhouse gas emissions. PRT also produces less noise and vibration than other form of conventional transit.

Quality of Life Benefits

PRT has the potential to increase land availability by creating a PRT enabled mixed-use district which contains all essentials of daily life within a maximum combined transit/walk trip of approximately 10 to 15 minutes. By attracting more riders to the public transit system, facilitating a higher density of housing, and serving as a circulator within the district, the need for a vehicle for intra-district trips is eliminated, in effect reducing overall parking demand. Where there is still a demand for parking, the PRT system reduces the need for on-site parking by providing access to long-term vehicle storage on the perimeter.

By reducing parking and vehicle travel and supporting higher density, mixed-use developments, PRT supports the development of vibrant 24-hour street life with an improved pedestrian and bicycle environment. The result is an area with improved air quality, reduced ambient noise and increased physical activity. Shifting from car ownership to PRT will also reduce transportation costs for households.

Safety Benefits

Research and development have proven the safety and reliability of PRT. The Morgantown PRT, the only fully operational system in the world, has completed over 110 million injury-free passenger miles since 1974. Comparatively, in 2008 automobile travel in the US averaged 80 injuries and 1.27 fatalities per 100 million vehicle miles traveled. Specific PRT safety features include:

- Computer control to eliminate human error
- Grade separation to eliminate pedestrian/vehicular conflicts
- Lower maximum speed
- Private trips

Economic Benefits

Many of the economic benefits of PRT are associated with the potential for transit-oriented development that could be support by the system. If realized, the increased development opportunities would generate additional property tax revenue. The housing component of TOD would expand the affordable housing supply and attract new residents who would contribute to an increase in retail sales and an associated increase in sales tax revenue.

Because PRT reduces overall parking demand within the service area, the capital cost of new parking facilities, approximately $15,000 per space, would be significantly reduced. PRT also supports the development of remote facilities to accommodate the remaining parking demand at a reduced cost due to lower land values.

Facilitation of development inside the urban core will prevent development of the surrounding automobile dependent towns, and thus prevent an influx of daily commuter traffic into the city. This would reduce the cost associated with additional road infrastructure and maintenance, policing, and accidents. Finally, by providing the opportunity for increased development within the PRT service area, rural land can be preserved allowing agricultural uses to continue and support the tourism industry.

Benefits over Other Modes

There are many reasons why people are advocating for more intelligent mobility and why many U.S. cities have seen public transit use on the rise. Americans need options that are less expensive, faster, and more environmentally friendly. However, most people who live in small to mid-sized American cities are dependent on automobile technology and infrastructure for their daily mobility needs because transit alternatives are not available. The following PRT characteristics allow it to draw a greater percentage of riders out of the private automobile than other public transit modes:

- Private Automated Trips
- 24-hour On-demand Service
- Fast Non-Stop Service
- Coverage and Convenience
- Accessible
- Environmental Appeal

In addition to increased ridership attraction, PRT has smaller right-of-way requirements than other transit modes which contribute to its lower capital cost. The capital cost of a PRT system is estimated to be a third of Automated People Mover (APM) systems, half of light rail, and more than one fifth the cost of heavy or metro rail. The BRT busway is the only transit system that is cost competitive with PRT. However this type of system requires allocation of at-grade right-of-way which is not always available in mature cities. With regard to operating and maintenance (O&M) costs, PRT has the potential to compete with the low operating costs of heavy or metro rail and consistent with the costs of light rail. The O&M costs of a PRT system can also compete with the cost of small bus transit systems and personal automobile ownership.

Finally, as an emerging technology, PRT provides potential economic development opportunities through:

- research and development,
- manufacturing,
- planning and design, and
- support and operations industry.

Potential Challenges

The study documents that there are several potential challenges that will need to be overcome for successful PRT implementation.

- PRT is still an emerging technology. There is limited depth of experience in the industry and safety, security and technical standards, specific to PRT operation in the United States, have not been developed.
- PRT is best suited for low density travel. It may not be possible to achieve minimum headways which would make it difficult to meet peak hour demand.
- Perhaps the most politically contentious aspect of PRT, besides capital cost, is the visual impact. Visual impacts would apply to any system with a dedicated right-of-way or fixed guideway.

Next Steps

This study evaluated the feasibility of a PRT system in Ithaca, NY. In general the study has concluded that a PRT system can be physically accommodated within the existing built environment of a mature city like Ithaca and that a PRT system in conjunction with transit-oriented development would provide substantial environmental, quality of life and economic benefits to the region. However, the study has also identified several areas that will require additional research before the City and the region can make a decision to pursue the implementation of a PRT system in Ithaca. Once the decision is made to pursue a PRT system, the approval requirements identified in this memorandum will need to be obtained and a financing strategy finalized. It is recommended that the following planning steps be pursued in the next few years to determine if a PRT system should be pursued for the City.

Short-Term

- Technology Assessments – There is a need to continue to track the status of research and development of both guideway type and propulsion systems to determine which are most appropriate and commercially available for implementation in Ithaca.
- Master Plan – There is a need to conduct a more detailed planning study of PRT development in Ithaca.
- Benefit/Cost Analysis – There is a need to develop more detailed capital and O&M cost estimates and summarize the anticipated benefits in monetary terms so that a benefit-cost ratio can be calculated.
- Public Involvement Process –There is a need to both educate the community on the technology and solicit their input on its potential in Ithaca. This process should include renderings of how the system could be integrated within the existing infrastructure of Ithaca as well as animations showing how a PRT system operates to overcome the potential challenges associated with new technology and visual impacts.
- Identification of Ownership/Operation Structure – There is need to evaluate potential ownership and operating structures to determine which is the most appropriate for implementation in Ithaca.

Long-Term

Upon completion of the short-term tasks, if it is determined that a PRT System in Ithaca should be pursued, the next steps include procurement, engineering and system implementation and testing.

Application in NY Beyond Ithaca

Developing a PRT system in conjunction with implementing policies to promote transit oriented development (TOD) has the potential to reduce VMT and associated greenhouse gases while enhancing the quality of life and economic development. Urban areas with over 30,000 jobs, as well as college campuses and activity centers, are suitable locations for the introduction of PRT.

Issues Requiring Additional Research

The following were issues were identified as requiring additional research beyond the scope of this feasibility study:

- System Components/Vendor
  - Selection of guideway type
  - Selection of propulsion system
- Route/ROW
  - Feasibility of using private property and structures for stations
  - Feasibility of integrating utilities into the PRT infrastructure
  - Identification of locations for storage/maintenance facilities
- Constructability
  - Maintain access to adjacent buildings during construction,
  - Utility clearances and potential relocation,
  - Maintenance and protection of traffic,
  - Potential disruption of the groundwater,
  - Potential impacts to adjacent buildings,
  - Crossing of Six-Mile Creek, and
  - Use of existing structures for stations.
- Ridership Projections including perceived attractiveness of PRT by potential users
- Detailed Cost Estimate
  - Cost comparison of PRT to other modes particularly bus transit, private automobile use, and car share programs. In particular the capital and maintenance cost for the road infrastructure and how it contributes to the O&M cost per passenger mile for automobile or bus use.
  - Cost of expanded services, most notably schools and social services, needed to serve the transit-oriented development (TOD) supported by a PRT system and how this may reduce the potential economic benefits.
- GHG emission reductions associated with reduction in idling due to congestion

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