Viability of Personal Rapid Transit in New Jersey Study

NJ Department of Transportation
Senior Staff Briefing

11-XX-05

Agenda

- Background and Study Elements
- PRT Technology Overview and Features
- PRT History and Vendor Status
- Cost and Performance Comparisons
- Potential Applications in New Jersey
- Next Steps for New Jersey
Viability of PRT in New Jersey

Background

- **New Jersey Senate Bill #341, Assembly Bill #2031**
  - Passed 10/18/04

- **Directs Department of Transportation, in consultation with NJ TRANSIT to**
  - Conduct a study of Personal Rapid Transit
  - Assess the viability of integrating PRT into New Jersey’s existing intermodal transportation system

**Report shall include:**

- Description of PRT technology and providers
- Comparison of cost, performance and impacts of PRT with other transportation modes
- Evaluate potential to reduce congestion in New Jersey including qualitative case study analysis
- Recommendations for advancing PRT in New Jersey if deemed appropriate by decision makers

Study Elements

- **Task 1 – Review literature and document current status of PRT**
  - Synthesize and catalog national/international literature
  - Survey and interview industry experts
  - Survey and interview leading PRT developers
  - Conduct technology assessment

- **Task 2 - Conduct qualitative case study analyses of potential PRT applications in New Jersey**
  - Develop a framework to compare PRT to other modes
  - Select and prepare two qualitative case study evaluations of potential PRT implementation in NJ

- **Task 3 - Develop recommendations to guide decision makers regarding possible implementation of PRT in New Jersey**
Technology Overview – What is PRT?

- **Fundamental elements of PRT technology:**
  - On-demand, origin-to-destination service
  - Small, automated vehicles
  - Small, exclusive use guideways
  - Off-line stations
  - Network of connected guideways

- **Combines elements of automotive, computer, network and transit design**

- **Uses current state of the art in control, communication and propulsion technology**

- **Technology enablers:**
  - Linear electric motors
  - On-board switching and guidance
  - High speed controls and communications

PRT Videos and Simulations

- **PRT Videos**
  - Taxi 2000
  - Ultra
  - Cabintaxi
History of PRT – Overview

- Concept originally developed in the 1950’s
- Subject of world-wide development in the 1970’s
- Multiple prototype systems developed under Federal Government funding in the 1970’s
- Four Major International PRT Conferences
- One “semi”-PRT system in operation at Morgantown, WV
- Multiple studies conducted around the world on the merits and implementation of PRT
- No fully-developed system available
- Multiple development programs still underway
- Recent procurements in London and Dubai

History of PRT – Early Development (1970’s)

- Jet Rail - USA
- Cabtrack – England
- CVS – Japan
- Aramis – France
- Krauss Maffei – Germany
- Alden – USA
- Dashaveyor – USA
- Airtrans – USA
- Otis TTI – USA
- Uniflo - USA
History of PRT - Aerospace Corporation (1968-1976)

- Conducted large PRT development program between 1968 – 1976
- Developed operational, economic and technology theories, programs, and models
- Designed and constructed prototype system demonstrating the use of advanced switching, small vehicles, small guideways and short headways
- Resulted in the publication of an advanced concepts textbook
- Terminated program due to lack of federal funding

History of PRT - Morgantown GRT System (1972 – present)

- Project funded with Federal Funds with short schedule and limited R&D
- System designed and built by Boeing:
  - Uses larger group vehicles requiring large guideway with a large physical footprint
  - Very expensive to construct and maintain because it involves custom components
- System has been in continuous operation since 1972
- Demonstrates the successful use of several PRT concepts, including: off-line stations and automatic control systems with a high level of reliability and low operating costs
History of PRT - Raytheon/Chicago RTA Program (1990’s)

- Program funded through $50M public/private partnership
- Initial designs included small vehicle and guideway but evolved to include a larger vehicle and guideway
- Test track demonstrated the successful use of full automatic control and off-line stations
- Program cancelled in 1999 due to changes in political leadership and non-competitive system features:
  - Large vehicles and guideways resulted in high capital costs, greater visual impact, with only moderate performance
- Program failed to learn from critical design lessons learned as part of past efforts

History of PRT – Implementation and Evaluation Studies

- PRT technology has been extensively reviewed:
  - 1975 Urban Mass Transit Administration (UMTA) Review
  - 2003 ATRA Study
- Major PRT applications have been studied including:
  - 1974 - Denver
  - 1980 - Indianapolis
  - 1995 - Chicago Rosemount
  - 1997 - Seattle SeaTac
  - 1998 - Sweden
  - 2001 - Cincinnati
  - 2002 – Korea
  - 2003 – European EDICT

- PRT often identified as a preferred or desirable mode but not selected because the technology has not been sufficiently tested in a “real world” operating environment
Viability of PRT in New Jersey

History of PRT – Results from Past Studies

- **Seattle SeaTac MIS Study**
  - Activity center circulation and connector to airport and regional rail
  - Significant local support for system and technology
  - 9% reduction in overall surface traffic in study area
  - Study recommended to establish public/private partnership for DBOM when technology is available

- **Cincinnati Central Area Loop**
  - Downtown circulator and cross-river connector
  - 3-5 times increased in ridership of alternative modes
  - Project 17,000-32,000 trips/day
  - Significant support of PRT by business and developer community
  - Disagreement of vendor and consultant over costs and service
  - PRT desired but rejected due to lack of existing prototype

- **Indianapolis Downtown study**
  - 33% projected mode share for area-wide system
  - Project halted due to lack of technology and political support
  - Current study underway at Indianapolis University

- **Minneapolis Downtown Study**
  - 8% projected mode share and 73,000 trips/day

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**EDICT – Sweden Kungens Kurva**
- Large shopping area seeking to reduce congestion, improve travel time and connect with regional rail
- PRT network selected with 12 km of guideway and 12 stations
- 26% reduction in average travel time
- 300% increase in ridership over bus
- 17% increase in overall area demand due to improved service
- 8% reduction in road traffic
- 35% of capital and 60% of operating cost for comparable fixed guideway alternatives

**EDICT – Cardiff Wales**
- Redevelopment of docklands next to city center
- Considerable economic modeling and traveler acceptance testing
- 5 mile network project to serve 5.7 million trips per year
- 100% operating and significant capital cost recovery
- 348,00 person-hours/year reduction in congestion
- 8% increase in mode share
- Preferred deployment of PRT upon funding approval
Lessons Learned from History

- **Technology is almost ready**
  - A wide range of technology configurations have been developed and tested
  - Control systems in 1970’s were not able to deliver required levels of performance but have since advanced
  - Fundamental concept is sound and technology components are now available and proven

- **Design is critical**
  - All systems had one or more economic, environmental, technical, service, or political flaws that stopped the program from advancing but provided direction for future developments
  - The overall design and integration of system features is a critical success factor
  - Additional systems engineering is needed to define the right combination

- **Careful development is needed**
  - Picking a design before alternatives analysis is potentially fatal
  - Alternatives analysis requires time, patience and sufficient funding without pressure for deployment
  - Further development and testing is needed before public service will be possible

Vendor Status – Ultra System

- Developed since 1995 in Wales by Advanced Transport Systems in conjunction with University of Bristol
- Strong European government and private partner support
- Currently operating a test track
- Recently selected for implementation at Heathrow airport with investment from British Airport Authority

- **Technology Components:**
  - Automotive form factor
  - Battery power, rotary motors
  - Moderate speed and capacity
  - Open guideway
  - Guided steering
  - Synchronous control system
  - As currently designed, not well suited for cold climate operation
Vendor Status – SkyWeb Express System

- Developed since 1982 by Taxi 2000, including considerable research and systems engineering
- Original funding provided by the University of Minnesota with limited additional funding and partnerships formed with manufacturing firms
- Limited function prototype is currently available, but no test track
- Considered in most PRT studies for the past 20 years

Technology Components:
- Body on bogie form factor
- Vehicle LIM propulsion, guideway power
- High speed and capacity
- Narrow enclosed guideway
- On-board switch
- Distributed asynchronous control
- Suitable for cold climate operation

Vendor Status – Posco/Vectus System

- Developed since 2003 primarily funded by Posco Steel of Korea
- Initial partner in study for Fornebu in Oslo Norway
- Extended development program in cooperation with Korean universities
- Partnerships formed with European firms
- Currently developing a test track in Upsalla Sweden

Technology Components:
- Body on bogie form factor
- Guideway LIM propulsion
- High speed and capacity
- Open guideway
- On-board switch
- Distributed asynchronous control
- Suitable for cold weather operation
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Vendor Status – CabinTaxi System

- Developed in the 1970’s with funding from German federal government
- System involved multiple design iterations involving advanced operating characteristics
- A fully operational test track with 24 vehicles was constructed and operated until 1980, demonstrating high reliability
- Cabinlift system operating since 1976
- Program cancelled in 1980 due to lack of federal funding; however, the system is still actively marketed

Technology Components:
- Body on bogie form factor
- Vehicle LIM propulsion, guideway power
- Moderate speed and capacity
- Enclosed over/under guideway
- On-board switch
- Distributed asynchronous control
- Suitable for cold weather operation

Vendor Status – Other Current PRT Developers

- **Micro Rail – Texas**
  - Privately funded
  - Mix of vehicle configurations
- **EcoTaxi – Finland**
  - Partner with Kone Elevator
- **Oceanier – Florida**
  - Responding to Destiny Program
- **Frog/2getthere/Park Shuttle**
  - Automated guided vehicle
- **Austrans**
  - Group Rapid Transit
Vendor Status – Summary

- **Active or past test track operation**
  - ULTra, CabinTaxi, Raytheon, CVS, Morgantown, Aramis, Frog

- **Prototype development**
  - SkyWeb Express, Vectus, Microrail, Coaster, Ecotaxi

- **Technology**
  - Components are proven and widely used
  - System engineering, final design and testing still needed
  - Optimum configuration of components yet to established

- **Acceptance**
  - Transit industry hesitant to accept PRT due to lack of pilot system
  - Cities and regions continue to display interest in PRT but disqualify PRT due to lack of proven technology

- **Research and development**
  - Developers are limited due to lack of market acceptance and financial backing
  - Korean, Swedish and British development programs underway

Current Application Interest

- **Great Britain**
  - Heathrow Airport Joint Venture Development
  - Daventry and 5-10 other sites

- **United States**
  - Houston Airport, Destiny USA, Pleasanton, Indianapolis, Seattle

- **Dubai UAE**
  - Financial District and Private Developments

- **Korea**
  - Rail Research Institute Joint Venture Development

- **Europe**
  - 5-10 EDICT applications
  - Stockholm, Fornebu, Helsinki
  - Uppsala Vectus Joint Venture Development
Task 1 Conclusions

- **PRT Readiness**
  - PRT has undergone significant research, engineering, development and application studies for over 40 years.
  - Past efforts and current designs provide a solid foundation for final engineering and development.
  - Advanced technology components are proven and ready to support an integrated PRT system design.
  - An optimum configuration and viable vendor base has not been established.

- **According to the literature, PRT can provide a number of potential benefits:**
  - Higher level of service than bus and other transit modes
  - High capacity, area-wide coverage
  - Lower operating costs than rail options and comparable operating costs with bus service and the automobile
  - Lower capital costs than all rail options
  - Lower energy consumption and environmental impact
  - Lower government involvement

- **Proponents and critics note that claims of potential benefits are largely theoretical at this time:**
  - With the exception of the Morgantown GRT, there are no PRT systems in active operation.

Comparing PRT to Other Modes

- **Mode comparison Framework:**
  - Average speed of travel
  - System capacity
  - Capital costs
  - Operating and maintenance (O&M) costs
  - Revenue vs. O&M costs
  - Other:
    - Congestion
    - Environmental
    - Right-of-way
    - Utility
    - Safety & Security

- **Existing transit mode data from national databases and NJ TRANSIT**

- **PRT data from literature and information provided by leading vendors**
PRT Performance Comparison – Average Speed

- Average speed is determined by line speed, number of stops, distance between stops, dwell time at stops, and trip length.
- PRT systems can achieve an average speed of 20-25 mph with line speed of 25-30 mph due to non-stop trip.
- PRT trips can be 80-100% faster than a typical bus trip.
- PRT trips can be 20-30% faster than a typical heavy rail trip.
- All else being equal, higher average speed can result in higher patronage.

Source: 2005 APTA Fact Book

PRT Performance Comparison – Capacity

- Line capacity is determined by headway, vehicle capacity and load factor.
- PRT systems can have comparable line capacity with bus and light rail if safe and reliable short headway operation is achieved.

Transit Mode Line Capacity

Source: TCRP Transit Capacity Manual
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PRT Capital Cost Comparison

- Capital costs are highly specific to location, line layout, number and complexity of stations.
- Given the design of PRT systems with small vehicles and guideways, capital costs can be expected to be lower than other exclusive, grade-separated, fixed guideway rail systems.
- PRT costs can be expected to be comparable with exclusive right-of-way BRT systems.
- Lower capital costs would be primarily due to:
  - Smaller guideway and stations
  - Reduced civil work and right-of-way acquisition

<table>
<thead>
<tr>
<th>Mode</th>
<th>Capital Cost/Mile ($M)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
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<tr>
<td>Metro Rail</td>
<td>$110</td>
</tr>
<tr>
<td>Light Rail</td>
<td>$25</td>
</tr>
<tr>
<td>APM – Urban</td>
<td>$20</td>
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<tr>
<td>APM - Airport</td>
<td>$49</td>
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<tr>
<td>BRT Busway</td>
<td>$7</td>
</tr>
<tr>
<td>BRT Tunnel</td>
<td>$200</td>
</tr>
<tr>
<td>PRT One Way</td>
<td>$15</td>
</tr>
<tr>
<td>PRT Two Way</td>
<td>$20</td>
</tr>
</tbody>
</table>


Operating and Maintenance Costs

- Operating and maintenance (O&M) costs per passenger-mile are highly dependent on ridership, system efficiency and system scale.
- PRT systems can be expected to offer comparable O&M costs to heavy and commuter rail if deployed effectively and to moderate scale.
- PRT systems can be expected to demonstrate lower O&M costs than current automated people mover (APM) systems at airports and the Morgantown GRT due to:
  - Higher expected levels of automation
  - Greater use of modern and standardized components
  - Simplified design and mechanical wear reductions
  - Reduced energy use
- PRT systems could be expected to experience comparatively high O&M costs if deployed in limited service areas with small patronage demand.
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O&M Cost Comparison

O&M Cost Per Passenger Mile

Source: 2005 APTA Transit Fact Book, NJT, FTA, Case Studies, PRT Vendors

O&M Cost and Revenue Per Trip Comparison

- O&M cost recovery is 34% nationally and 48% for NJT operated services
- PRT systems can be expected to recover a higher percentage of O&M costs if fares reflect per mile O&M cost
- PRT in a moderate scale New Jersey application can expect to break even for an average four mile trip and average fare of $1.60.

Source: 2005 APTA Transit Fact Book, NJT, FTA, Case Studies, PRT Vendors
Potential PRT Applications

**Urbanized Area:**
- Central Business District circulator
- Neighborhood connector
- Feeder to existing transit stations/hubs
- Connector/distributor from satellite parking facilities
- Potential alternative to local LRT or BRT service
- Urban goods movement

**Activity Center/Campus:**
- Circulator within entertainment/tourism district
- Circulator within/between college campuses
- Airport landside and airside access
- Feeder to existing transit stations/hubs
- Connector/distributor from satellite parking facilities

Examples of Potential PRT Applications in NJ

**Urbanized Area:**
- Harrison
- Hoboken
- Jersey City
- Long Branch
- Morristown
- Newark
- Trenton

**Activity Center/Campus:**
- Meadowlands Sports and Entertainment District
- Atlantic City
- New Brunswick – Rutgers University
- Suburban employment nodes:
  - Bridgewater-Raritan-Somerville
  - Cherry Hill
  - Metropark
  - Parsippany Troy Hills
  - Piscataway
  - Secaucus
  - Woodbridge
Potential PRT Application – Meadowlands Entertainment District

- Potential Features:
  - Connect major venues within the district
  - Circulate and distribute visitors within the district
  - Provide feeder service to future commuter and light rail stations/stops
  - Provide access to remote areas including satellite parking
  - Designed to accommodate future expansion to adjacent areas
  - Could be a potential alternative to future light-rail extension

- Potential Benefits:
  - Improve flow and movement of visitors within the complex
  - Allow increased density of development and replacement of parking
  - Increase transit access and usage to neighboring areas
  - Reduce traffic congestion on roadways adjacent to and within complex
  - Higher level of service with lower capital and operating costs than alternative options

- System Description:
  - Xx – xx miles of guideway, $xx - $xx capital cost

Potential PRT Application – Atlantic City

- Potential Features:
  - Connect major hotels, casinos, convention center, and parking areas
  - Connect to rail line
  - Circulate and distribute visitors within the area
  - Provide access to remote areas including satellite parking
  - Can accommodate future expansion to adjacent neighborhoods and other areas
  - Provide potential for goods and baggage distribution

- Potential Benefits:
  - Improved flow and movement within the area
  - Increase transit access and usage to neighboring areas
  - Allow increased density of development and replacement of parking
  - Increased attractiveness and prestige to the area
  - Reduce traffic congestion on roadways throughout the area

- System Description:
  - Xx – xx miles of guideway, $xx - $xx capital cost
PRT Choices for New Jersey

- **Option 1 – Monitoring and Support**
  - No State involvement at this time, monitor technology development and reconsider State participation in the future as PRT technology development advances

- **Option 2 – Research and Analysis**
  - Participate in research and analysis activities that advance development, implementation and operation of PRT systems

- **Option 3 – Detailed Application Studies**
  - Conduct detailed application studies for future implementation of PRT in New Jersey, including cost, performance, ridership, layout, impact analysis, and public outreach for one or more potential applications

- **Option 4 – Public/Private Development Program**
  - Develop a public/private development partnership and execute a comprehensive program involving selection of initial applications, development of performance standards, testing of technology and initial system demonstration

Potential PRT Business Model

- PRT can evolve from a public system to a private utility business model
- PRT networks are based on standards similar to internet and cell phone networks
- Model based on franchise rights where developers build and operate integrated networks
- Government serves in a regulator role only
- Vehicle operators provide service on franchised networks
- Co-funded through revenue from fares, real estate development and limited public support
Supporting Information

- The following slides provide additional detail to the presentation topics

The Needs for Systems Engineering

- Personal Rapid Transit is a new system of many elements including:
  - Vehicles
  - Stations
  - Guideways
  - Power and propulsion
  - Control and communication

- Each element and function must be integrated with the functions of the other elements in order to allow the entire system to operate

- The elements, functions, technologies, configurations, mode of operations, and many other factors must be engineered separately and as a system to achieve an effective product

- The optimum combination of elements has yet to be widely accepted
On-demand, Origin-to-Destination Service

- **New concept for a fixed guideway transit system**
  - Provide non-stop operation in a public vehicle on public conveyance providing personal service on demand
  - Has been demonstrated in small scale

- **Requires:**
  - Small automated vehicles with short headways
  - Off-line stations
  - Network management and vehicle flow systems
  - Highly redundant and fault tolerant control and communications

- **Potential benefits include:**
  - Shorter wait times
  - No interim stops resulting in shorter trip times
  - Comfortable seated trip

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Small Automated Vehicles

- **Vehicles are sized to meet demand:**
  - 95% of trips are traveling groups of 3 or less
  - Typical PRT vehicle has 3-4 seats
  - Larger vehicles for group settings or baggage handling can be accommodated

- **Small vehicles, designed for seated passengers:**
  - Provide private, individualized service in a protected environment
  - Can comply with ADA requirements
  - Can accommodate freight hauling
  - Permit the use of smaller guideways with:
    - higher acceleration/deceleration
    - smaller guideway curve radius
  - Facilitate fleet sizing to match demand
PRT systems function on exclusive guideways either at-grade, elevated or underground.

When elevated, small vehicles permit the use of smaller guideways allowing:
- Higher acceleration/deceleration and smaller curve radii.

Smaller guideways have the potential to:
- Lower foundation requirements.
- Reduce disruption of existing infrastructure.
- Provide greater opportunity to integrate PRT within existing ROW and on existing bridges.
- Allow stations to be more easily integrated into existing buildings.
- Permit rapid, prefabricated modular construction.
- Reduce capital costs and visual impact.

Off-line Stations

Function like ramps on a freeway to maximize vehicle flow.

Need not be “one size fits all,” each station can be designed and sized to meet local demand.

Allow vehicles to move individually through a station or wait at station if there is no demand or to anticipate future demand.

Can accommodate high flow at larger stations with vehicles moving through in a platoon, similar to traditional rail transit.
Networks and Distributed Demand

- Conventional transit uses line-haul techniques to aggregate demand in corridors to minimize impact and costs.

- PRT systems use interconnected, scalable networks of guideways to access a larger population and provide greater individual mobility.

Comparison - Congestion

- Congestion can be reduced by attracting drivers from their cars with a service that:
  - Provides a shorter overall trip
  - Serves desired origin and destination points
  - Is more convenient and comfortable
  - Costs the same or less than the trip in the car

- PRT can reduce congestion more effectively than other transit modes by:
  - Providing higher average speeds and shorter overall trips
  - Providing wider access through lower cost infrastructure
  - Providing on-demand, seated, private service
  - Providing competitive fares supported by lower operating costs
PRT Performance Comparison – Capacity

- Overall line capacity is determined by headway between vehicles, capacity of vehicles and load factor.
- System capacity is determined by the overall capacity of the network of lines that serve the demand area.
- PRT systems can have adequate line capacity and high system capacity due to potentially lower capital costs and increased line and station distribution.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Heavy Rail</th>
<th>Light Rail</th>
<th>Busway</th>
<th>PRT</th>
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<tr>
<td>Headway (sec)</td>
<td>120 - 200</td>
<td>60 – 360</td>
<td>15-300</td>
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<tr>
<td>Vehicle/Train Capacity</td>
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<td>240 – 360</td>
<td>40-70</td>
<td>3-6</td>
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<td>Theoretical Line Capacity 1k Persons/hour</td>
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<td>2-20</td>
<td>0.5 - 16</td>
<td>3.6 – 28</td>
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<td>0.5-0.7</td>
<td>0.3 – 0.6</td>
<td>0.2- 0.5</td>
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<td>1- 11</td>
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Source: TCRP Transit Capacity Manual

Capital Cost Comparison

- Metro Rail
  - NY 2nd Avenue Subway $2,000M/mile
  - LA Red Line $250 M/mile
  - Dulles Metro Extension $170 M/mile

- Light Rail
  - LA Gold Line $65 M/mile
  - Minneapolis Hiawatha Line $60 M/mile
  - Houston Metro $43 M/mile
  - NJ New River Line $29 M/Mile

- Automated Guideeway
  - JFK Airtrain $148 M/mile
  - Seattle Monorail $150 M/mile
  - Indianapolis Clarian $15 M/Mile

- Busway
  - Exclusive average (GAO) $13.5 M/Mile
  - HOV average (GAO) $9.0 M/Mile

- PRT
  - Ultra $9-$13M/mile One way
  - Taxi 2000 $15-$24M/mile
  - Cabintaxi $20 $M/mile Two-way
  - Austrans $13- $40 $M/mile

Rail figures are for 2-way configurations. PRT systems are typically in 1-way configurations.
Viability of PRT in New Jersey

### PRT Capital Costs

- **Raytheon PRT**
  - $27-$37 M/mile estimate for Rosemount site
  - Large guideway and large vehicle system

- **Cabintaxi**
  - $21 M/Mile estimate for detail Hamburg application preliminary engineering
  - 2-way over/under guideway

- **Ultra**
  - $9 - $13 M/Mile estimates from preliminary layouts in multiple European cities
  - Considerable preliminary civil engineering

- **Taxi 2000**
  - $16-$24 M/Mile estimates from case studies and prototype development

- **Yoder Comparison Study**
  - $15-$48 M/mile using statistical analysis of 17 AGT systems
  - Comprehensive component analysis

- **Clarian People Mover**
  - $15 M/mile for privately built APM system

### PRT Operating Cost Comparison

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Commuter Rail</th>
<th>Bus</th>
<th>Light Rail</th>
<th>M-PRT</th>
<th>PRT</th>
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<td>US</td>
<td>NJT</td>
<td>US</td>
<td>NJT</td>
<td>US</td>
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<tr>
<td>Average Trip Length (mi)</td>
<td>11.5</td>
<td>5.1</td>
<td>24.8</td>
<td>23.3</td>
<td>6.2</td>
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<tr>
<td>Revenue/Trip</td>
<td>$2.39</td>
<td>$0.97</td>
<td>$4.39</td>
<td>$3.79</td>
<td>$1.60</td>
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<td>Operating Cost/Trip</td>
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<td>$0.21</td>
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<td>Total Cost/Pass-mi</td>
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<td>$0.61</td>
<td>$0.59</td>
<td>$0.66</td>
<td>$0.87</td>
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Notes:
- NJT: New Jersey Transit Authority
- US: United States
- NJT: New Jersey Transit Authority
- US: United States
- NJT: New Jersey Transit Authority
- US: United States
Viability of PRT in New Jersey

PRT O&M Costs

- **Ultra Claims**
  - $0.30/pass-mi operating cost from EDICT trials

- **Taxi 2000 Claims**
  - Total capital and operating $0.38/pass-mi
  - Operating cost of $0.22/pass-mi

- **FTA APM 1992 Transit Data (Updated to 2005)**
  - $/seat-mile Low $0.07 Average $0.13 High $0.50
  - $/pass-mile Low $0.21 Average $0.40 High $1.50

- **OTA AGRT 1980 Assessment (Updated to 2005)**
  - $/pass-mile Low 0.25 Average $0.46 High $2.70

- **Morgantown**
  - $/pass $1.43 $/pass-mile $0.85

- **Expected PRT O&M Costs**
  - $/pass-mi Low $0.30 Average $.40 High $0.80

Vision for PRT Development and Deployment

- **Opportunity to develop a new mode of transportation that could address urban transportation issues in New Jersey and around the world**

- **Opportunity to develop a new industry centered in New Jersey**

- **Common problem effectively addressed by private/public partnerships**
  - State, local and federal government
  - Manufacturers, suppliers and developers

- **Development effort with distributed funding and participation to share the risk and increase the potential of success**

- **Focused program driven by performance requirements, economic incentives, commercial viability and sustainability**

- **Coordination to avoid analysis paralysis and design by committee**
Option 1 - Monitoring and support

**Action:**
- Play no active role in the development of PRT. Monitor PRT development activities conducted by others and reconsider State role in the future, as appropriate

**Pro’s:**
- No state commitment of funds
- No risk of selecting sub-optimum technology configuration
- Other groups take the risk of development and initial implementation

**Con’s:**
- PRT programs may only continue with limited success
- PRT programs may fail to secure investment funds resulting in little or no additional PRT development is achieved
- PRT development activities may favor technology solutions not appropriate for New Jersey (e.g., cold weather operation)
- New Jersey may miss an opportunity to develop a new PRT business/industry centered in the State

Option 2 - Research and Analysis

**Action:**
- Conduct research and studies in areas that will benefit the understanding, development, implementation and operation of PRT systems
- Support the development of tools, techniques and data that will support the understanding, development, implementation and operation of PRT systems

**Pro’s:**
- Support the understanding and advancement of the technology
- Provide foundation for effective demonstration and implementations
- Guide and shape the technology and industry
- Build a body of knowledge and experience base of engineers, designers and planners
- Support the coordinated development of technology

**Con’s:**
- Research without a commitment to move forward based on results may have limited effectiveness
- Use of resources and funds may be questioned without public endorsement
- Research external to a systems engineering and development program may pursue non-relevant topics of interest
Option 3 - Detailed Application Studies

**Action:**
- Conduct research and analysis activities to advance the current understanding, development, implementation and operation of PRT systems

**Pro’s:**
- New Jersey’s research could provide a foundation for effective demonstration and implementation of PRT systems
- Participating in research may elevate New Jersey’s stature as a leader in helping to guide and shape a new technology and industry
- Can help to ensure that research related to PRT technologies appropriate for New Jersey advance
- Could provide a base of knowledgeable and experienced engineers, designers and planners to support growth of a PRT industry in New Jersey

**Con’s:**
- Research without a commitment to implementation may have limited effectiveness
- New Jersey assumes some financial risk by investing in research that may not have tangible results in the short term
- Research occurring outside of a comprehensive systems engineering and development program may be of limited use
- Even with additional research, PRT developers may fail to secure investment funds resulting in little or no additional PRT development

Option 4 – Public/Private Development Program

**Action:**
- Build public/private partnership to conduct a comprehensive $50-$70M program to develop and test one or more PRT technologies. Involve enough private and public partners to limit New Jersey share of program costs to $10-$15M.

**Pro’s**
- Provides New Jersey with the opportunity to demonstrate international leadership in shaping the future of the technology
- Provides an opportunity to structure program around New Jersey applications
- Provides an opportunity to create a network of engineers, planners, technology developers, manufacturers, and support organizations in New Jersey to foster the creation of a new PRT industry in the State
- Provides an opportunity to share potential risks, funding and future rewards
- Shortens implementation time frame and provides a higher probability of success with an opportunity for the State to receive return on investment from revenue sharing and economic development
Option 4 – Public/Private Development Program

**Con’s:**
- New Jersey must make a moderate commitment of limited public funding to support the development partnership.
- Given the nature of a public/private partnership, there is some potential to develop sub-optimal technology solutions (e.g., Chicago RTA experience).
- Public/private partnerships are vulnerable to leadership change over time, which could negatively impact success especially if political support weakens, or technology development is delayed.