Viability of Personal Rapid Transit in New Jersey Study

NJ Department of Transportation
Senior Staff Briefing

11-XX-05

RUTGERS

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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

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

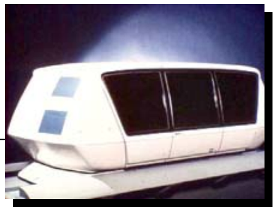
- **PRT Videos**
  - Taxi 2000
  - Ultra
  - Cabintaxi

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
  - 1972, 1973, 1975, 1996
- 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)

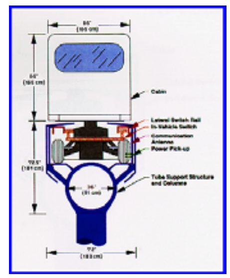
- Conducted large PRT development program between 1968 – 1976
- Developed operational, economic and technology theories, programs, and models
- Designed and constructed prototype system demonstrating the use of advanced switching, small vehicles, small guideways and short headways
- Resulted in the publication 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**

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

History of PRT – Results from Past Studies

- **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

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
- **Oceaneering – 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

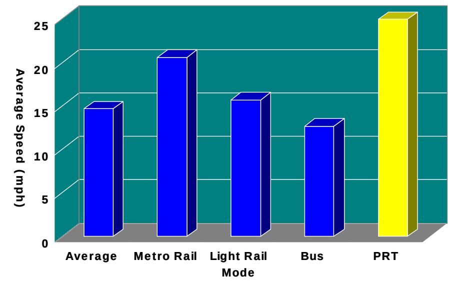
- **PRT Readiness**
  - PRT has undergone significant research, engineering, development and application studies for over 40 years
  - Past efforts and current designs provide a solid foundation for final engineering and development
  - Advanced technology components are proven and ready to support an 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

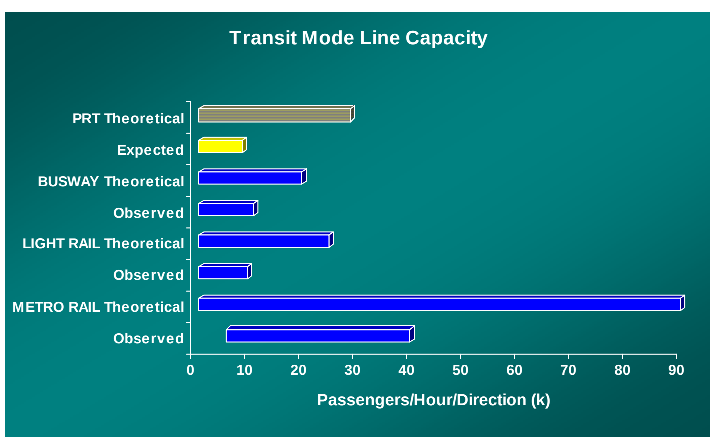
- **Average speed is determined by line speed, number of stops, distance between stops, dwell time at stops, and trip length**
- **PRT systems can achieve an average speed of 20-25 mph with line speed of 25-30 mph due to non-stop trip**
- **PRT trips can be 80-100% faster than a typical bus trip**
- **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**



Source: TCRP Transit Capacity Manual

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

	Capital Cost / Mile ($M)		
Mode	Low	Average	High
Metro Rail	$110	$200	$2,000
Light Rail	$25	$50-$70	$195
APM – Urban	$20	$100-$120	$145
APM - Airport	$49	$100-$150	$237
BRT Busway	$7	$14-$25	$50
BRT Tunnel	$200	$250	$300
PRT One Way	$15	$20-$25	$40
PRT Two Way	$20	$25- $30	$50

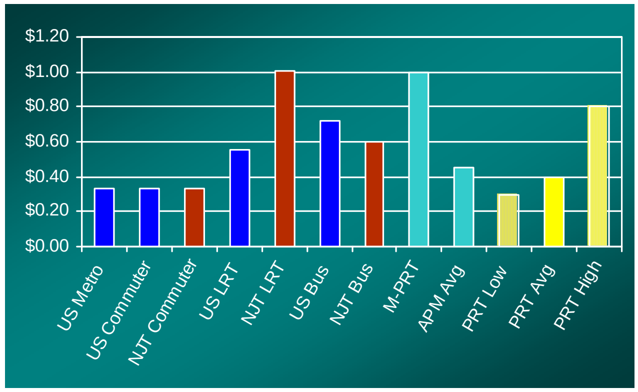
Sources:Kerr-2005, TCRP –R90, GAO – BRT 2000, Vendor Estimates, Case Studies

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**

O&M Cost Comparison

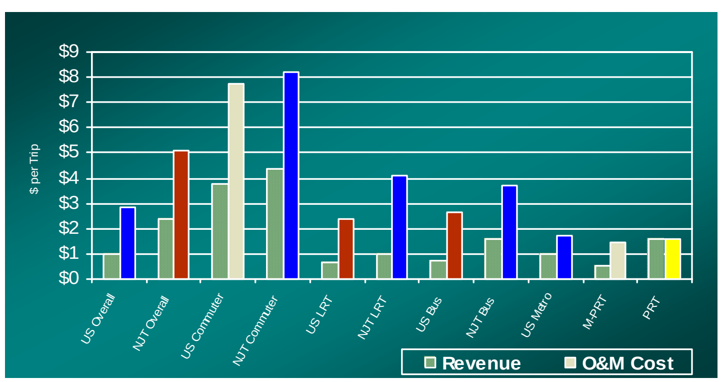
O&M Cost Per Passenger Mile



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

O&M Cost and Revenue Per Trip Comparison

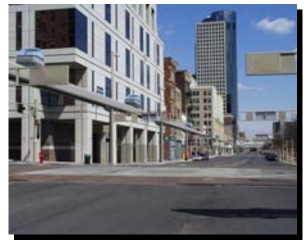
- **O&M cost recovery is 34% nationally and 48% for NJT operated services**
- **PRT systems can be expected to recover a higher percentage of O&M costs if fares reflect per mile O&M cost**
- **PRT in a moderate scale New Jersey application can expect to break even for an average four mile trip and average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

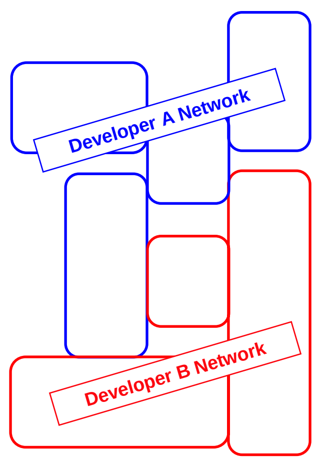
- **Potential Features:**
  - Connect major hotels, casinos, convention center, and parking areas
  - Connect to rail line
  - Circulate and distribute visitors within the area
  - Provide access to remote areas including satellite parking
  - Can accommodate future expansion to adjacent neighborhoods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

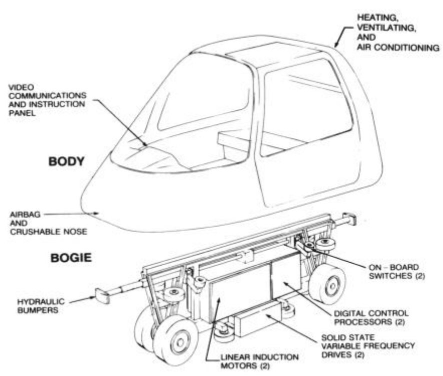


Supporting Information

- 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 separetly 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

Small Automated Vehicles

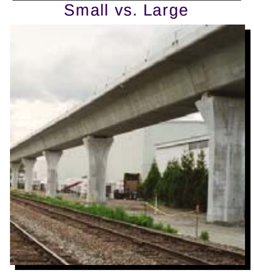
- **Vehicles are sized to meet demand:**
  - 95% of trips are traveling groups of 3 or less
  - Typical PRT vehicle has 3-4 seats
  - Larger vehicles for group settings or baggage handling can be accommodated

- **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

Small Exclusive Use Guideways

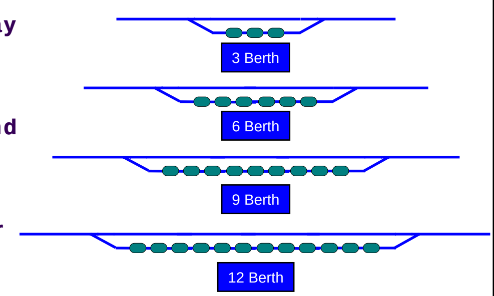
- **PRT systems function on exclusive guideways either at-grade, elevated or underground**
- **When elevated, small vehicles permit the use of smaller guideways allowing:**
  - Higher acceleration/deceleration and smaller curve radii
- **Smaller guideways have the potential to:**
  - Lower foundation 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

Small vs. Large



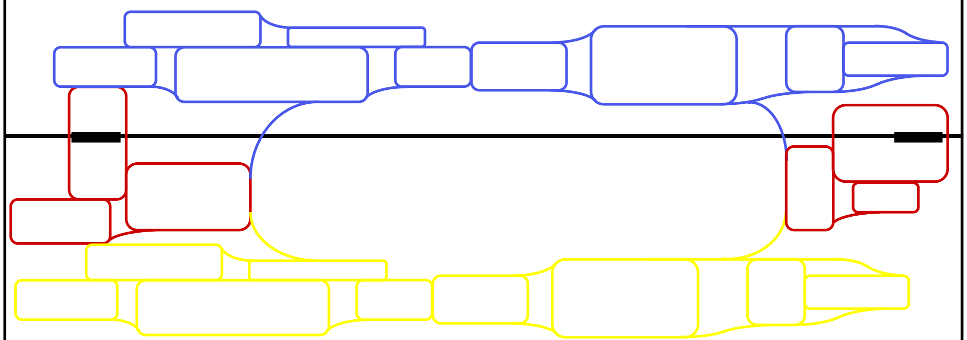
Off-line Stations

- **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

Mode	Heavy Rail	Light Rail	Busway	PRT
Headway (sec)	120 - 200	60 – 360	15-300	0.5 – 3
Vehicle/Train Capacity	360 – 3000	240 – 360	40-70	3-6
Theoretical Line Capacity 1k Persons/hour	6-90	2-20	0.5 - 16	3.6 – 28
Peak Load Factor	0.4– 0.8	0.5-0.7	0.3 – 0.6	0.2- 0.5
Observed Line Capacity 1k Persons/hour	6 -50	1- 10	1- 11	1- 9

Source: TCRP Transit Capacity Manual

Capital Cost Comparison

- **Metro Rail**
  - NY 2nd Avenue Subway — $2,000M/mile
  - LA Red Line — $258 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 Guideway**
  - 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

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

	Overall		Commuter Rail		Bus		Light Rail		M-PRT	PRT
	NJT	US	NJT	US	NJT	US	NJT	US		
Average Trip Length (mi)	11.5	5.1	24.8	23.3	6.2	3.7	3.6	4.4	1.7	4.0
Revenue/Trip	$2.39	$0.97	$4.39	$3.79	$1.60	$0.75	$1.01	$0.68	$0.50	$1.60
Operating Cost/Trip	$5.11	$2.85	$8.20	$7.76	$3.73	$2.68	$4.13	$2.41	$1.43	$1.60
Revenue/Pass-mi	$0.21	$0.19	$0.18	$0.16	$0.26	$0.20	$0.28	$0.16	$0.30	$.40
Operating Cost/Pass-mi	$0.44	$0.56	$0.33	$0.33	$0.60	$0.72	$1.13	$0.55	$0.85	$0.40
Total Cost/Trip	$8.78	$4.25	$15.13	$13.80	$4.13	$3.25	$40.22	$9.30		
Total Cost/Pass-mi	$0.76	$0.84	$0.61	$0.59	$0.66	$0.87	$13.59	$2.13		

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

Viability of PRT in New Jersey

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-$15 M.
- **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 provide 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