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ENG 300

Personal Rapid Transportation

Saving Energy through Alternative Transportation Modes

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Personal Rapid Transit

- As many of you heard me say, it's cool – then there's the rest of it!

- Personal rapid transit is a generally unknown and undeveloped subset of a class of transit systems known as Automated People Movers (APMs).

http://faculty.washington.edu/jbs/itrans/PRT/Background.html

Personal Rapid Transit

- The concept isn't new--the basic idea goes back at least to the 1950s. But it hasn't caught on for a variety of reasons, including the cost of the initial systems and the difficulty of integrating them into existing cities.

http://www.technologyreview.com/energy/22083/

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Personal Rapid Transit Definition

- In 1988, the Advanced Transit Association adopted a set of guidelines that define a true PRT system.
- In brief, the guidelines state that a PRT system should have:
  - Fully automated vehicles capable of operation without human drivers.
  - Vehicles captive to a reserved guideway.
  - Small vehicles available for exclusive use by an individual or a small group, typically 1 to 6 passengers, traveling together by choice and available 24 hours a day.
  - Small guideways that can be located aboveground, at ground level or underground.
  - Vehicles able to use all guideways and stations on a fully coupled PRT network.
  - Direct origin to destination service, without a necessity to transfer or stop at intervening stations.
  - Service available on demand rather than on fixed schedules.

http://faculty.washington.edu/jbs/itrans/PRT/Advocacy_Groups.html

Personal Rapid Transit Implementation

- Two Personal Rapid Transit (PRT) systems are being installed this year, one at Heathrow International Airport, near London, and one in the United Arab Emirates, where it will be the primary source of transportation in Masdar City, a development that will eventually accommodate 50,000 people and 1,500 businesses and is designed to emit no carbon dioxide.

  http://www.technologyreview.com/energy/22083/

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Energy Efficiency

- Theoretically more energy efficient than other public transportation [1]
  - Only move on demand
  - Fewer unused seats
  - Fewer stops/starts

Vehicle	BTUs per passenger mile
On-call vehicles (i.e. taxi)	14,301 [2]
Buses	4,235 [2]
Automobiles	3,512 [2]
Transit rail	2,784 [2]
Motorcycles	1,855 [2]
Vanpool	1,322 [2]
ULTra PRT (estimate)	839 [3]

[1] Anderson, J. Edward, "A Review of the State of the A
Journal of Advanced Transportation, vol. 34, pp. 3-29. 2000.
[3] http://cta.ornl.gov/data/chapter2.shtml, Table 2.12
[2] http://www.solarevolution.com/solutions/presentations

Scalability figures

- 2-passenger cars can move a maximum of 3600 passengers per line per hour with 2-second following distance
- More capacity can be added by adding more lines, decreasing following distance (controversial), or moving more passengers per vehicle (rideshare programs) [1]
- Rail moves 2X-4X as many passengers per line per hour, but scheduled stops make travel time 3X as long [2]

[1] Johnson, Robert E. (2005). "Doubling Personal Rapid Transit Capacity with Ridesharing". Transportation Research Record: Journal of the Transportation Research Board, No. 1930. http://pubsindex.trb.org/document/view/default.asp?lbid=803547. Accessed 4/6/09
[2] http://en.wikipedia.org/wiki/Personal_rapid_transit

Infrastructure cost

- Infrastructure cost estimates vary widely, but is expected to be on the order of building new roads [1]
- Average estimates $10M-$15M per mile for guideway construction [2]
- Theoretically lower operating cost due to increased energy efficiency, but no real-world figures exist yet.

[1] http://en.wikipedia.org/wiki/Personal_rapid_transit
[2] http://www.atsltd.co.uk/uploads/Documents/infrastructure_cost_comparisons.doc

SNL Focus Areas

- Increasing the efficiency of PRT
  - Modeling and simulation
  - Material sciences
  - Alternative energy exploration
- Increasing the safety of PRT
  - Red team analysis
  - Tamper detection
  - Vehicle bomb detection
  - Vehicle impact analysis

"We don't make the PRT system, we make the PRT system better"

PRT Surety

- Integrate trace explosives vehicle portal, allowing better throughput
- Test and evaluate vulnerabilities of PRT control systems using the IORTA red team
- Perform full scale tests on how PRT vehicles respond in accident environments

PRT Modeling and Simulation

- PRT systems struggle with appropriate routing, passenger capacity, and quantity of vehicles
- Leverage existing transportation simulation model (TRANSIMS)
  - Compute activity times and locations for each individual for route planning and traffic simulations
  - Transportation network includes streets, transit stops, parking lots, and transit lines
  - Improve the route planning algorithms for both safety and efficiency purposes

Gaining Public Support

- New Idea (for many people)

"Now, I'm beginning to understand why GM is having so many problems"

GM PUMA electric vehicle

http://topics.nytimes.com/top/reference/timestopics/subjects/n/new_york_auto_show/index.htm

- Unproven Concept

"A lot of sites want to be the second location to try Personal Rapid Transport"

Masdar City, Abu Dhabi's new post-petroleum city

http://www.ameinfo.com/182351.html

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Gaining Public Support (cont.)

- Other Issues
  - Where do they fit in for a transportation system – airport? downtown area? City?
  - Initial investment – elevated or tunneled guideway could cost up to 300 million/mile
  - Detract from the cityscape
  - Emergency and handicapped access – difficult to accommodate?

Heathrow Airport Drawing

http://www.technologyreview.com/energy/22083/

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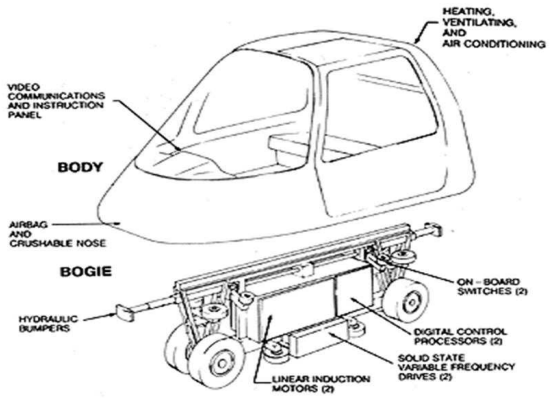
Safety

- Compared with other modes of public transportation
  - Public transit is thought to be much safer than private motoring
  - There is debate on whether or not Automated Guideway Transit system (AGT), are safer than other forms of rail-based transit

- Individual system safety is application dependent
  - How will the control system monitor vehicles location?
  - How will the vehicles interact?
  - What safety features will be available on the vehicles?
  - How will emergency access be handled?



Conceptual Vehicle Configuration (OCI Report)

http://oki.org/pdf/loopfinalreport.pdf

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Malicious Intent

- PRT is vulnerable to vandalism, terrorism, sabotage
  - Central control system
  - Unmanned vehicles
  - miles of unattended track

Taxi 2000 Photo Simulation – Downtown Cincinnati

http://oki.org/pdf/loopfinalreport.pdf

- The system could actually be used to deliver explosives, etc

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This PRT concept is difficult to realize...

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Too hard to power the system, so let's leverage human energy

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Grids too restrictive, remove the guide ways and add steering

Too heavy of a body, drop the vehicle encasement…

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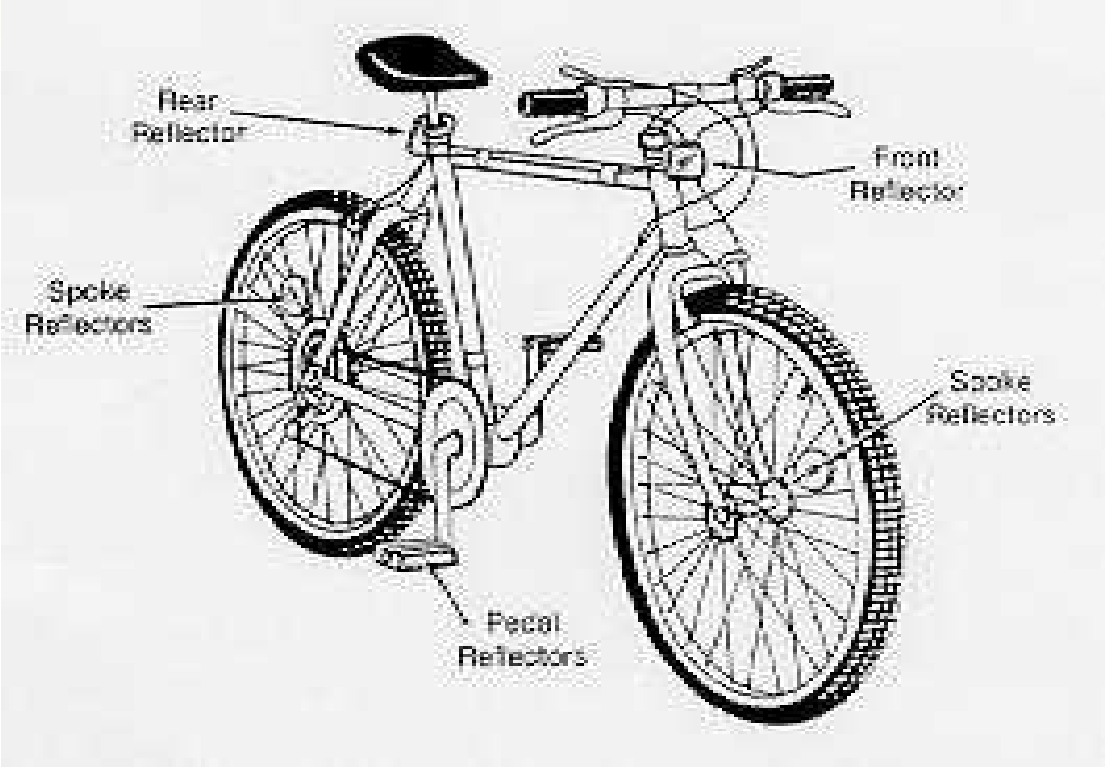
We have something viable that you can purchase today



I think I'll just walk instead

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