Personal Rapid Transit for Emeryville

Some background information by Cities21, July 26, 2005

This introductory paper will:

- Describe PRT technology
- Explain an associated out-of-the-box paradigm
- Describe how PRT fits within a larger "comprehensive door-to-door mobility" service
- Comment on the status of PRT technology development
- Explain the main implementation challenges
- Comment on PRT's visual impact
- Provide supporting quotes

PRT TECHNOLOGY

PRT is an elevated monorail system with many three-person, driverless, electric vehicles. It is ideally suited for short "feeder/distributor", shuttle, and "circulation" operations at train stations, airports, office parks, and shopping centers. PRT provides non-stop, no-wait, 30 mph service.

Vehicles travel above ground on 16' elevated "guideway." Stations are located near building entrances. Many stations are situated along the route to minimize walking once the trip ends. Vehicles travel non-stop to their destination along the main guideway at 30 mph, speeding at twice the average speed of autos on congested streets below. Stations are NOT located on the main guideway; instead, stations are located on separate station guideway that branches from the main guideway. Thus, stations are described as "off-line," meaning "not on the main line."

PRT combines concepts from monorail (Disneyland), automated people movers (SFO Airport), roller coasters, and automated highway systems (Governor Schwarzenegger's GM OnStar van drives itself in the science fiction movie The Sixth Day).

Passengers travel alone or with people of their choosing. Vehicle weight minimization greatly reduces the size of the elevated guideway and supporting columns, dramatically reducing construction cost and right of way acquisition. Vehicles flow along the guideway almost like data packets on the Internet, anticipating demand so that wait time is eliminated. In addition to improving commute alternatives, the PRT system eliminates mid-day stranding caused by traditional carpooling/transit, by providing efficient transit to adjoining shops and restaurants.

PRT system capacity is roughly 4,000 person trips per hour per PRT "loop." Systems may have many loops, providing more capacity.

OUT-OF-THE BOX PARADIGM

Recent national studies by the Texas Transportation Institute and the Brookings Institution conclude that there is no 'silver bullet' to reduce traffic congestion. A more accurate conclusion is that our current national tool kit for reducing traffic congestion is ineffective, thus new tools should be developed.

Electric trolleys first became operational in 1888, and provided much faster service than the horse carts that they replaced. Cities granted franchise agreements to real-estate speculators who built and operated trolley systems as a means to build new homes. Within a few years, trolleys were the dominant mode of transit. This real-estate driven franchising model is also quite promising for PRT. Franchisees take on the investment risk instead of taxpayers. The current public policy context often focuses only on transportation

benefits, but transit works better economically when also used as a means to a real-estate ends. By reducing traffic congestion, PRT enables new real-estate development within suburban areas where traffic congestion currently limits or prohibits growth.

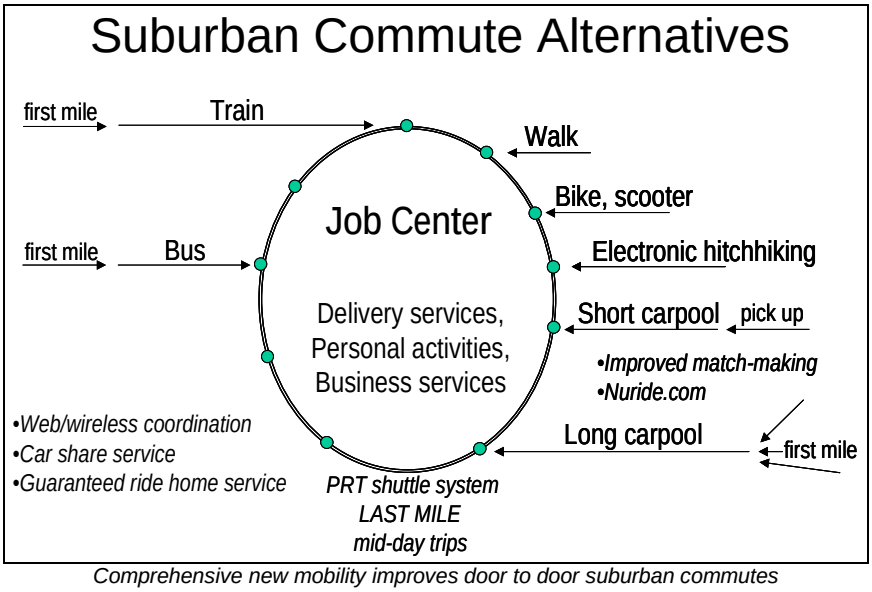
With the current set of transit tools, transit agencies are often forced into capital-intensive investments using 100-year-old technology, frequently with capital costs in the billions, and with no hope of ever covering annual operating costs. One of the major drawbacks of older transit technology is that riders only come from within a small 20-acre / 500-person area surrounding transit stations. PRT offers a better solution than expensive transit line extension investments. By serving as a feeder to existing transit stations, PRT can bring 20,000 people within a short PRT ride of those transit stations. Thus, PRT can profitably create huge increases in conventional transit ridership. The current insufficient transit toolkit forces an emphasis on adding new subsidized transit, rather than on improving the operating economics of existing transit investments.

COMPREHENSIVE MOBILITY

The transportation political system is broken into many separate and competing agencies. Within this policy context it is difficult to provide a seamless, customer-centered, multimodal transportation system. But this is what is really needed to get travelers to and from destinations. U.C. Researcher Susan Shaheen defines "comprehensive new mobility" as "pairing clusters of smart technologies with existing transportation options to create a coordinated, intermodal transportation system that could substitute for the traditional auto."

A study of a 20,000-person Palo Alto office park explored the impact of a hypothetical PRT feeder system coupled with comprehensive new mobility. This hypothetical service significantly increased the attractiveness of commuter rail, carpool, vanpool, bicycle, and bus commutes. This new service increased transit market share from 0% to 19.75%, increased carpooling from 9.6% to 32.1%, and shrank solo driving share from 89% down to 45.6%.

Suburban commute alternatives are diagramed below. The PRT Shuttle solves the "last mile" problem, efficiently connecting different commute alternatives to workplaces. A stylized version of a PRT shuttle system is shown below as an oval with many stations blanketing the job center with efficient feeder/distributor service:



Comprehensive new mobility improves door to door suburban commutes

Of particular note, driving alone requires very little conscious thought. People drive alone following their route out of habit, focusing very little of their mental capacity on the driving. To compete with driving alone, commute alternatives must become simpler.

Train and bus commuters face the "first mile" problem as well: how to get to the train station or bus stop in their home city. If we provide a solution for the last mile (and mid-day stranding) that often provides sufficient motivation for commuters to solve the first mile problem.

Without PRT, carpoolers typically worked in the same building, meaning that finding a carpool partner who lived nearby was a significant challenge. By providing efficient distribution, PRT breaks this restriction. Carpoolers travel to the edge of the employment center, park at the most convenient employer lot, and then ride PRT to reach their workplaces. With 20,000 workers serving as potential carpool matches, the spatial matchmaking probability improves dramatically.

By rapidly connecting within an entire major employment center, PRT provides sufficient scale for centralized commute services such as “guaranteed ride home”, car sharing, and car rental.

The Palo Alto study found combined annual revenue and cost savings of $16.9M, with $326M one-time profit from real-estate redevelopment of 50 acres of reclaimed parking spaces.

PRT DEVELOPMENT STATUS

PRT is an emerging technology under development in Minnesota (SkyWeb Express), Texas (Microrail), the United Kingdom (ULTRA), and Korea. The original PRT concept was invented in the U.S. 40 years ago, and has been independently derived on numerous occasions since. SkyWeb has one vehicle and a 60' test track segment. Former Microsoft employees have provided the majority of their funding. A $4M SkyWeb earmark stalled in the Minnesota state 2004 legislative session. Microrail has one vehicle and one short guideway section. ULTRA has a 1km "figure 8" test track with two vehicles. ULTRA is partnering with TRW on advanced sensor technology research. In 2001, ULTRA lined up $68M in public sector funding, but that commitment was later withdrawn. The European Union provides ongoing ULTRA-based PRT research funding and views PRT as an important part of the Kyoto Protocol effort. The Korean Government has recently announced a $30M PRT R&D program. First commercial deployment for any of these systems could be as early as 2008.

Two important procurements are currently underway for transit systems at Heathrow Airport in London and at Dubai International Financial Center (a free-trade skyscraper center) in the Persian Gulf. Either procurement could fund the world's first PRT system.

PRT IMPLEMENTATION CHALLENGES

PRT technology will be difficult to implement, and especially difficult to implement in a cost-effective manner. Multiple efforts may be required – it is not at all clear that the first fully funded effort will succeed. PRT represents the first truly new transportation mode since the airplane. It is useful to reflect on the difficulty in bringing about the airplane. Before the Wright Brothers succeeded, there were many failed attempts (collectively known as the "Wrong Brothers"). Many very intelligent people believed that man would never fly.

It is possible to produce PRT at a low delivered cost of $10M per mile, as well as a high $40M per mile. A model whereby engineers have financial incentives to keep costs down will be more advantageous than that of a traditional "cost plus" manufacturer that passes on cost overruns to taxpayers. Likewise, IBM required a "skunkworks" culture to bring about the PC, and a similar structure may be necessary for PRT. Traditional component vendors may be forsaken for cost-conscious roller coaster and gondola makers, or even Daimler-Chrysler's semi-autonomous GEM subsidiary. The winner of the DARPA grand robotic vehicle challenge spent $1M to claim the $1M prize. The second place finisher, the Golem Group, spent only $35K. Golem provides another excellent example of desired PRT vendor characteristics.

PRT systems share more in common with today's complex hardware/software systems than with the traditional civil/transportation engineering discipline. The largest technical challenge is in developing the "control system" that safely choreographs vehicles maneuvering only 10 feet apart. In order to obtain liability insurance, the control system safety must be proven via a painstaking, time-consuming process.

Most of PRT control system technology has already been prototyped in research projects such as: U.C. PATH's automated car tailgating, Frog Navigation's Park Shuttle, Daimler-Chrysler's Chauffer II truck tailgating, and Toyota's IMTS bus.

The European Commission's Research Director for Urban Sustainability claims the major PRT implementation obstacles have been non-technical in nature. One such problem is that no American city wants to take on the downside risk of hosting the first PRT system (many cities want to be the second host city). Our mature democracy favors incremental change while resisting large-scale innovative change.

PRT VISUAL IMPACT

The visual impact of the svelte PRT elevated guideway should be considered carefully. Dense suburban areas with modern architecture are the natural candidates to host the first futuristic PRT systems. To reduce visual impact, stations may be located inside building lobbies, or immediately adjacent to the second floor.

SUPPORTNG QUOTES

"Our current transportation policy path in the U. S. is clearly unsustainable. Traffic, its environmental impacts and its impact on quality of life continue to get worse virtually everywhere in the country. Innovative new ideas and new approaches are badly needed. We need a portfolio of innovative approaches spread across the United States, with each one pushing the envelope towards a more sustainable future transportation system. Cities21 and its Suburban Silver Bullet should be in this portfolio. It is innovative; it is forward-looking; it addresses many key transportation challenges; and the potential benefits - if widely disseminated - are large." - Steve Offutt, EPA's Best Workplaces for Commuters.

"I've long thought personal rapid transit would be a silver bullet for Edge City transportation woes if you could keep it as simple, customizable, scalable, affordable, and profitable as Legos. Cities21 may have cracked the code." - Joel Garreau, Edge City: Life on the New Frontier.

Peter Calthorpe (author: The Next American Metropolis) at the Congress for New Urbanism Conference (CNU XIII), June '05: *"We new urbanists didn't focus on the growth of office parks. This was a huge mistake. We need powerful strategies for these job centers. Also, one of my pet peeves is that we've been dealing with 19th Century transit technology. We can do better than that. We can have ultra light elevated transit systems with lightweight vehicles. With lighter vehicles, the system will use less energy."*

CNU President John Norquist, *"I've turned from a PRT skeptic to 'I wanna know more.' My previous view of PRT was Morgantown and the Buck Rogers schemes that pop up in Popular Mechanics from time to time. Using PRT to enrich a corporate campus is intriguing."*

REFERENCES / FURTHER READING

- Transportation Research Record: Journal of the Transportation Research Board, *Suburban Silver Bullet: PRT Shuttle and Wireless Commute Assistant with Cellular Location Tracking*, TRB, National Research Council, Washington, DC, Number 1872, December 2004, pp. 62-70. http://faculty.washington.edu/jbs/itrans/raneysb1.htm . Additional related papers: http://www.cities21.org/library.htm.
- Example franchising strategy: http://www.cities21.org/franchise.html
- Transportation Research Board Conference, January 2003, *Small-Suburb PRT Ballot Initiatives* (Emeryville, CA), http://www.cities21.org/PRTinitiative_TRB_4web.pdf