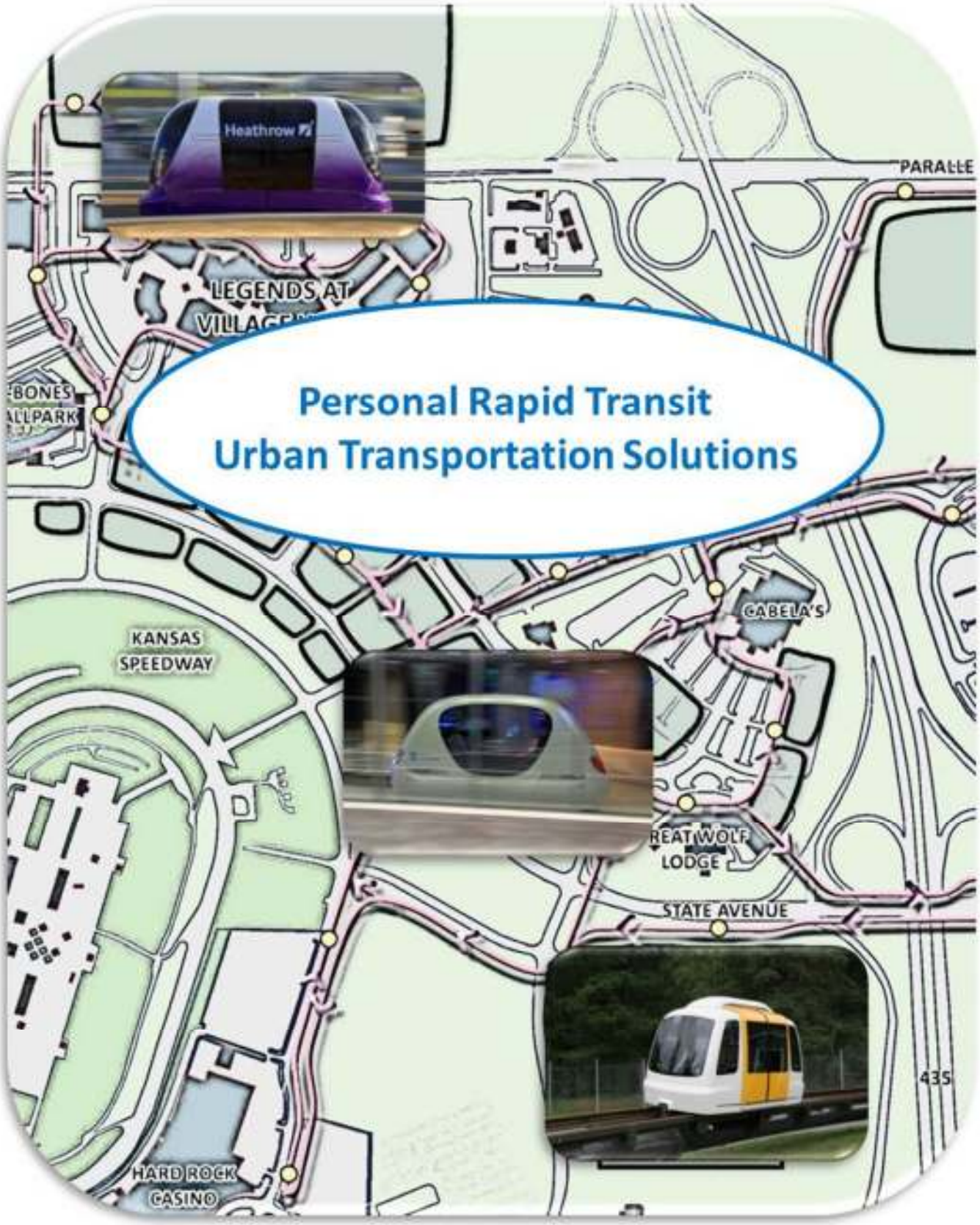
Heathrow
PARALLE
LEGENDS AT
VILLAGE
BONES
ALLPARK
Personal Rapid Transit
Urban Transportation Solutions
KANSAS
SPEEDWAY
GABELA'S
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HARD ROCK
CASINO

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Introduction

This booklet describes an exciting form of automated transit that has been in development for decades and is now available from a number of different suppliers. The reasons we need a new transportation system are obvious to many and are outlined below:

- Congestion keeps increasing
  - More and more people are moving to cities
  - More and more people are buying cars
  - Road infrastructure development struggles to keep pace
- Safety
  - Road accidents are the leading cause of death for those between 10 and 24 years of age[1]
  - Transit is typically not much safer
- Air pollution
  - While modern cars pollute less, this effect is offset by their increase in number
- Greenhouse gases
  - Transportation contributes about one quarter of all greenhouse gases
- Unliveable cities
  - Roads divide cities
  - Parking lots devour real estate
  - Asphalt paving causes heat islands
- Inaccessibility
  - About 30% of the population (children, the elderly and the disabled) are unable to drive and must rely on transit which is often inadequate
- Cost of transportation
  - Car ownership combined with the cost of supporting infrastructure is very expensive
  - Conventional transit is only affordable when large numbers of people use it. It is too expensive to provide at a neighbourhood level which results in many living far from convenient transit services.

What is needed is a transit system that is affordable to all and yet provides a high level of service. It must be very reliable and have short waiting times combined with quick trip times. It should be ten times as safe as present modes and it should not rely on oil for motive power. This booklet is about such a system.

[1] World Health Organization 2007

System Description

Personal rapid transit (PRT) is a form of driverless transit meeting the following general characteristics[2]:

- Direct origin-to-destination service with no need to transfer or stop at intermediate stations.
- Small vehicles available for the exclusive use of an individual or small group traveling together by choice.
- Service available on demand by the user rather than on fixed schedules.
- Fully automated vehicles (no human drivers) which can be available for use 24 hours a day, 7 days a week.
- Vehicles captive to a guideway that is reserved for their exclusive use.
- Small (narrow and light) guideways are usually elevated but also can be at or near ground level or underground.
- Vehicles able to use all guideways and stations on a fully connected PRT network.

PRT Vehicles (T-Pods)

T-Pods are typically sized to accommodate three to six seated passengers. However, some systems have the capability to mingle larger (20 – 30 passenger) vehicles in with the PRT vehicles.

2getthere T-Pod

ULTra T-Pod Interior

Vectus T-Pod

PRT vehicles are typically driven by rotary electric motors powered by rechargeable batteries or by linear induction motors obtaining power from the guideway. They can have rubber tires operating on a flat surface or steel/polymer wheels operating on rails. Some systems being developed are suspended below the guideway.

[2] Definition provided by the Advanced Transit Association

PRT Stations

PRT stations are typically located on sidings away from the main guideway. This “off-line” arrangement allows vehicles to take passengers nonstop to their destinations, bypassing T-Pods stopped in stations.

Unlike train stations where the platform must be as long as the longest train, PRT stations can be sized according to the demand. Thus a busy station will have more vehicle bays than a quiet station. This allows numerous small stations to be built economically. Since the stations are off-line, adding stations has no impact on the speed and flow of traffic on the guideways.

ULTra At-Grade Station

Vectus At/Above-Grade Station

2getthere Below-Grade Station

PRT Guideways

PRT vehicles are typically captive to dedicated guideways. Avoiding conflicts with cars and pedestrians while limiting conflicts with other T-Pods to merges and diverges (no crossings) is key to the extremely safe operation provided by PRT. For this reason guideways are usually elevated or below grade. At-grade guideways can be used if there is no need for crossing traffic.

Because of the light weight of PRT vehicles, elevated guideways only require an infrastructure similar to a pedestrian bridge. Elevated guideways can be designed to blend in with the surrounding architecture and/or to avoid areas with sensitive viewscapes.

Compare road above with PRT below

Taxi 2000 – urban PRT rendering

Comparison with other modes

Benefit	Transit	Car	PRT
New technology	✓	✓	○
Trip time	✗	○	○
Cost per passenger	○	✗	✓
On-demand 24/7	✗	✓	✓
Transfers	✗	✓	✓
Seated travel	○	✓	✓
Private	✗	✓	✓
Nonstop	✗	○	✓
Minimal waiting	✗	✓	✓
Accommodates disabled	○	✗	✓
Safe and secure	○	○	✓
User friendly	○	○	✓
Snow and ice	○	✗	○
Minimal walking	✗	✓	○
Sustainable	○	✗	✓
Energy efficient	○	✗	✓
Visually appealing	○	○	○
Reliable	✗	○	✓

Legend: Poor ✗ **OK** ○ **Good** ✓

PRT Suppliers

Three suppliers, 2getthere, ULTra and Vectus have commercially-available PRT systems. Many more are in various stages of developing systems as outlined in the table below. Open guideway systems typically have rubber-tired vehicles that steer themselves. Captive bogey systems have their wheels captured by the guideway which steers the vehicles. Suspended systems hang from the guideway which steers the vehicles.

PRT Technology Development[3]

Development Stage	Open Guideway	Captive Bogey	Suspended
Engineering Design	Move Mile	Taxi 2000, PRT Minnesota, PRT International, Cabin Taxi, City Coaster	Cabin Taxi, Skytran, Beamways, MISTER, Jpods
Test Track	ULTra	Vectus	-
Commercial Project	ULTra-Fairwood	Vectus	-
Public service	2getthere, ULTra	-	-

2getthere

2getthere is a Dutch company that has had driverless vehicles providing public transportation services for many years. These include the Rivium group rapid transit (GRT) system in Rotterdam and the Masdar PRT system that went into public service in 2010 in Masdar City, UAE. Both systems are battery-powered and run on rubber tires. The PRT systems runs at speeds up to 40 km/hr (25 mph) and at headways (time between vehicles) as low as 5 seconds

2getthere's Rivium GRT system

2getthere's Masdar PRT system

[3] As of August, 2011

ULTra PRT

Ultra's PRT system entered public service at Heathrow Airport in London in April, 2011. They anticipate commencing construction of a PRT system in Amritsar, India in late 2011 in a joint venture with Fairwood India. Their PRT system has rubber tires and is battery-powered. It runs at speeds up to 40 km/hr (25 mph) and at headways as low as 6 seconds.

ULTra's Heathrow Airport PRT system

Vectus

Vectus is a British company owned by Koreans and with a test track in Sweden. They recently commenced construction of a PRT system in Suncheon, South Korea. Their PRT system uses linear induction motors and runs on solid polymer wheels on a steel track. It runs at speeds up to 70 km/hr (44 mph) and at headways as low as 3 seconds.

The Vectus PRT system

Project Implementation Steps

The steps required for project implementation are outlined here. All steps may not be necessary for every project. However, a methodical process is recommended in order to avoid the project being undermined by unforeseen circumstances (such as uninformed public objection). The steps outlined below can be quite complex and it is highly recommended that professional assistance be obtained prior to commencing a PRT implementation project.

Stakeholder workshop

This is a meeting of key community leaders. The purpose is to educate them regarding PRT and then to have them agree on overall project goals. The workshop should be facilitated by somebody knowledgeable in PRT and experienced in running workshops. This person needs to be empathetic and encourage all opinions to be heard.

The results of the workshop should be documented and made available to the participants. A likely implementation step is the formation of a PRT Steering Committee comprised mostly of key participants of the workshop. The Steering Committee would meet periodically during the project to help ensure the major goals are being met and the best interests of the community are being kept in mind.

Public outreach

Any proposed PRT system that could suffer from adverse public comment, should have a well thought-out public outreach program. Public education and input should commence before there is any chance of members of the public learning about the project and becoming upset, because there are aspects of it they do not understand or that get misrepresented in the press. There are many instances of good public projects being stopped in their tracks by a vociferous minority.

Feasibility study

This study is necessary in order to determine the viability of the project. A key consideration will be the number of daily riders to be expected and the fare per ride they can be expected to pay. This information is considered in conjunction with the capital and operating costs of the system to determine the likelihood of obtaining funding.

Mode Preference	
Mode	Score
Personal Rapid Transit	661 (Best)
Low Impact Vehicle	588
Car	572
Bicycle	540
Walk	532
Jitney	467
Light Rail	467
Monorail	451
Commuter Rail	451
Paratransit	443
Maglev	443
Heavy Rail	435
High Speed Rail	435
Bus Rapid Transit	403
Express / Regional Bus	387
Shuttle Bus	387
Local Bus	346 (Worst)

Public outreach workshop results

Design development

This involves obtaining permits and advancing the design sufficiently that the most suitable PRT system can be procured.

System procurement and financing

Once the system has been procured and the project is ready to commence construction, financing can be obtained. If the system is financially viable, it should be possible to obtain financing for most or all of the construction costs. Costs not financed could be paid for from other funding sources that typically fund transit projects. It is possible that the financing could cover 100% of the costs, including the costs of the tasks leading up to procurement, such as the feasibility study and the design development. Financing is typically available for amounts ranging from US$50M to US$1B at interest rates between 6 and 8 percent and for terms of 20 to 30 years.

System construction and testing

This will typically take two to three years.

System operation and maintenance

The PRT supplier will usually also be the system operator. Fare revenues will be used to pay the supplier for operations and maintenance costs and to pay off the construction loan. Any excess fares (profit) will typically be shared by the supplier and the community.

Heathrow Airport guideway construction

Frequently Asked Questions

How can a system with small vehicles have sufficient capacity?
Cars are small vehicles yet roads have tremendous capacity. PRT computer controls allow many small vehicles to travel seconds apart. PRT guideways function as networks. In this way people do not have to all travel down one busy transit line. They can travel along numerous different lines all sharing the load.

What if the control computer crashes?
Special fault-tolerant computers are used. They are configured in redundant arrays so that each computer is backed up by others.

I might not feel safe with a computer driving
Elevators did away with operators years ago. Modern aircraft often perform fully-automated hands-off operations including landing in fog. Computers actually make much better drivers than humans.

These systems look complicated. Won't they break down often?
Both the Heathrow and the Masdar City PRT systems are operating well above their contractual requirements. More than 99% of all trips are accomplished within the designated parameters. The T-Pods continuously monitor their own health and withdraw from service immediately a problem is noted.

What about power outages?
PRT systems have redundant power supply at least sufficient to allow all T-pods to safely complete their trips.

Won't the system get clogged up with empty vehicles looking for passengers?
Empty vehicles do have to reposition themselves, but typically do so in a direction opposite to the peak (full vehicle) flow. One of the big advantages of PRT is that empty vehicles that are not needed simply go out of service. Other transit systems have to circulate largely empty vehicles in order to provide somewhat timely service in off-peak periods.

The speeds seem slow. Won't PRT take longer than transit?
Trip times are short because travel is nonstop. A 100 km/hr train that stops every 2 km only averages about 35 km/hr.

My car will take me to my destination. Transit only takes me to a station. Isn't PRT like transit in that I'll always have to walk the first or last mile?
Because PRT stations are offline and can be sized to demand, it is possible to space them less than 1 km apart. This means that the walking distances at each end are typically less than ½ km (about 5 minutes).

Will PRT operate in bad weather?
Different PRT systems have different solutions for weather conditions such as wind, snow and ice. Most PRT systems will deal with these conditions better than cars do.