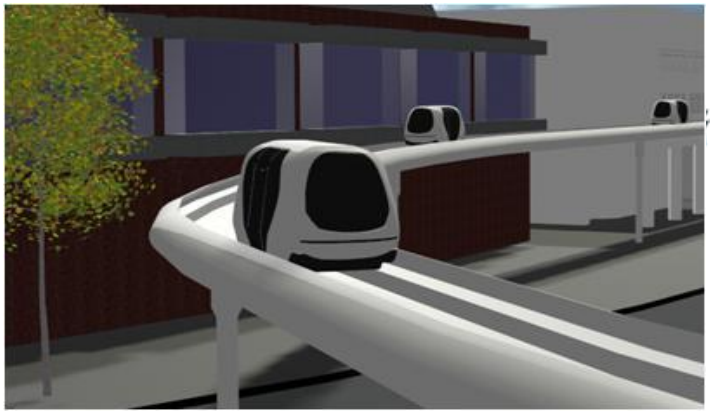
December 2012

Heathrow and the case for PRT

ultra global prt

Presentation by Fraser Brown, Managing Director Ultra Global PRT

Objective



ULTra: Urban Light Transport:

Started January 1995 at University of Bristol

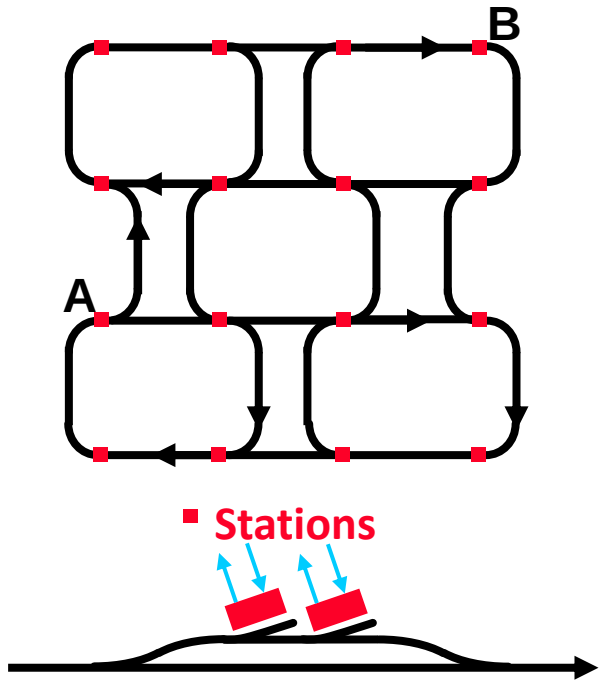
To define an urban transport system for the next century, meeting future needs for flexible personal transport, while being highly acceptable in an urban environment.

Passenger Requirements

Requirement

- Available on Demand
- Goes everywhere
- No Stops
- Environmentally friendly
- Safe and Secure
- Low Cost
- Integrates with other modes

Automated transport by small vehicles on a dedicated guideway network with off line stations



Run Heathrow VT

Passenger Requirements

Requirement	Delivered @ Heathrow
• Available on Demand	Average wait time ~ 10 seconds
• Goes everywhere	Can go to any point on the network
• No Stops	No stops
• Environmentally friendly	>50% reduction in energy and emissions
• Safe and Secure	Very reliable, fully monitored
• Low Cost	Less than half the cost of other modes
• Integrates with other modes	Complementary to conventional transport

Heathrow issues

- Congestion
- Space restrictions
- Pollution problems
- Capacity restrictions
- Passenger Service Issues

Heathrow pod

Heathrow pod is up, running, and since opening in May 2011 has carried 500,000 passengers.

Heathrow pod takes over 50,000 bus journeys off the road per year, saving over 200 tonnes of CO2 per year

Reliability

System	Availability
Heathrow Pod	99.5% (2011/2012)
Heathrow Express	98.0% (2010/2011)
London Underground (LUL)	95.6% (2010/2011)
Docklands Light Rail (DLR)	97.4% (2010/2011)
Tramlink	98.6% (2010/2011)
Overground	94.8% (2010/2011)

Average waiting time for a vehicle to arrive is only **10-15 seconds**, with 80% of passengers having no wait at all.

Figures from Transport for London

What do our passengers think?

- “Landed and used the very cool Heathrow pod – they’re even better to use – quicker, easier and greener that the buses to/from the car park”
- “I love these things. Best airport transfer devices ever”
- “Awesome sci-fi system”
- “Pass on my thanks to the team who designed this and also very importantly, the person(s) at BAA who approved this bold leap. It’s absolutely commendable to take charge and move forwards with a new transport system”

Passenger Feedback

- **Quality of Service Monitor (QSM) updated**

Category	Bus	PRT	
	2010	2011(Q3)	2011(Q4)
Ease of Getting to the Terminal	3.8	4.6	4.6
Overall Transfer Experience	3.9	4.5	4.6
Frequency of Transfer	3.5	4.6	4.7
Car Park Overall	3.8	4.2	4.2

- Over 60% of customers gave 5/5
- The best service on the airport – nothing scores higher as an individual score than 4.7
- Passengers are choosing to use the car park because of the pod

Awards Success

national transport awards

Highly Commended; **Most Innovative Transport Project**

ultra global prt

london transport awards 2012

Winner; **Most Innovative Transport Project**

The Great Exhibition 2012

Best in Britain

Most Innovative Service Award Winner 2012

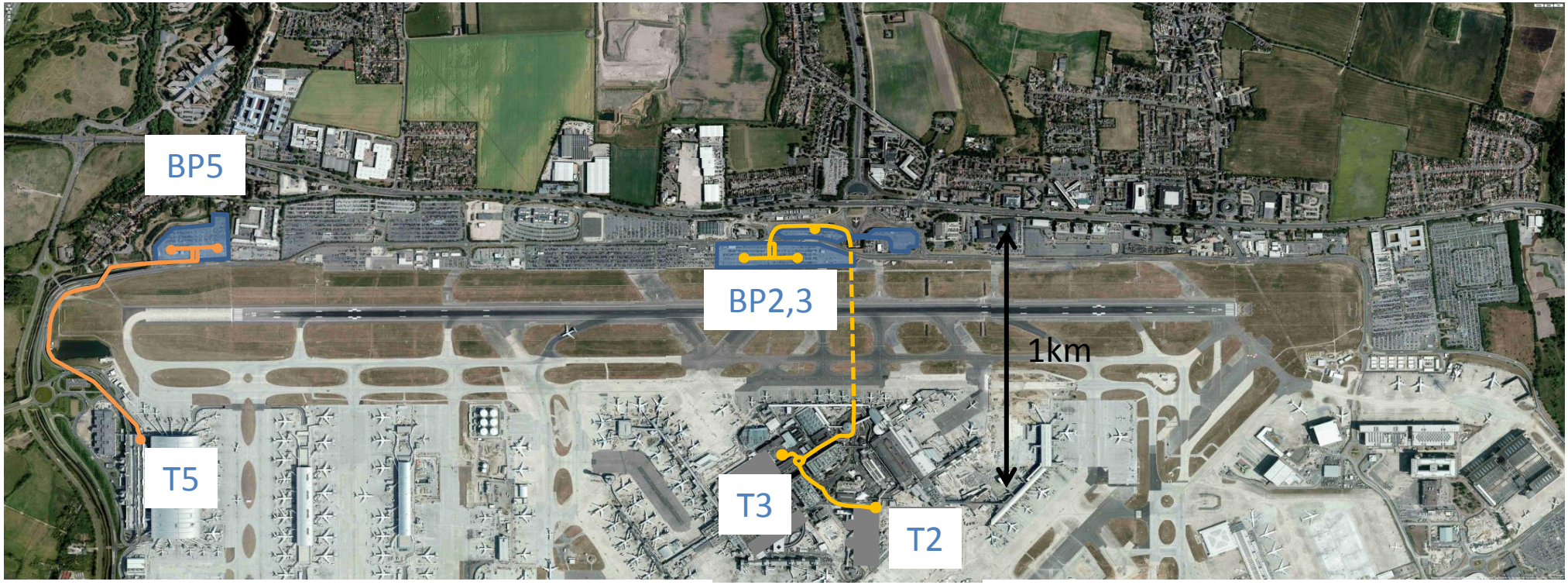
WINNER

The Global AirRail AWARDS 2012

Climate Week 12-18 March 2012

Shortlisted in the **Best Product** category

Next for Heathrow – same again please

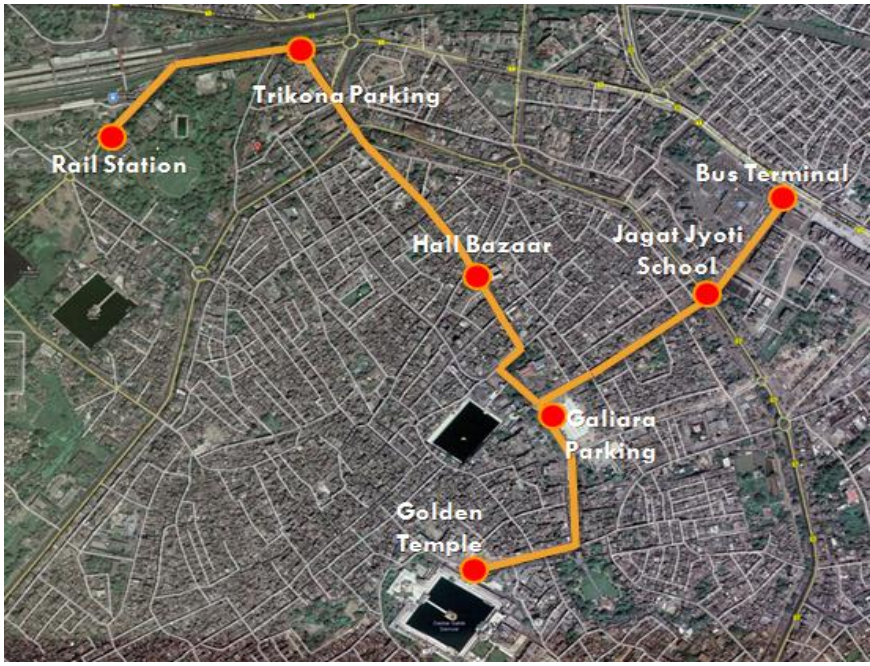


PRT in Amritsar, India

World's first and largest urban PRT system:

- 8km route with 240 vehicles, 7 stations.
- Peak demand of up to 100,000 passengers/day
- Saves up to 30 minutes on current journey times

Entirely privately financed, with farebox & advertising revenue key business case drivers



Thank you

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Backing Slides

Understanding PRT capital cost

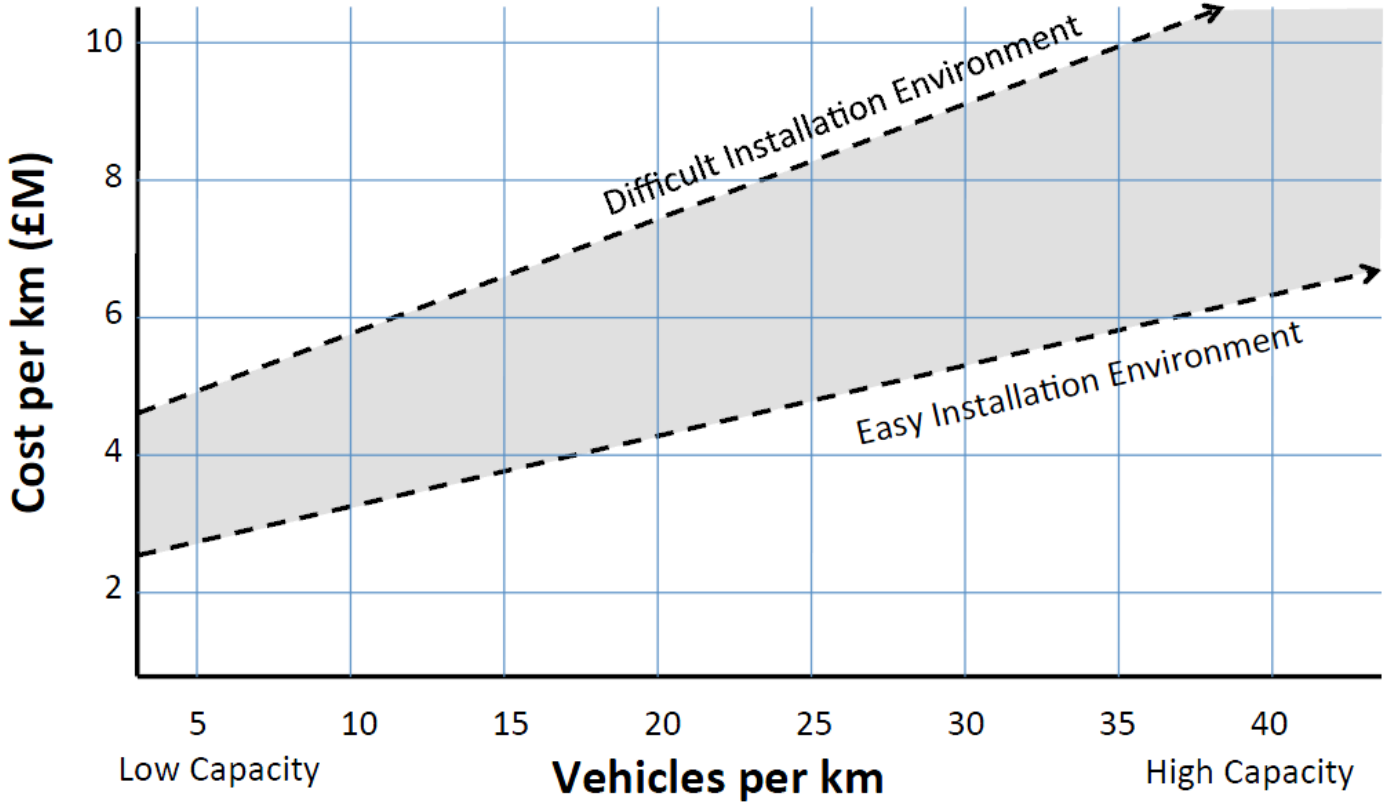
No single per-km cost is accurate representation

Cost depends on:

1) Site conditions

2) Demand to be served (capacity)

3) Location (e.g. India vs. UK vs. US, etc)



But...3-5 times cheaper than APM/Rail

- Light rail system at Toronto International Airport link cost nearly **£38m per km**
  - An Ultra system would have cost £9-10m per km (based on 2010 figures).
- The Birmingham AirRailLink cost over **£14m per km** to refurbish recently
  - To build a PRT from scratch for the same route would have cost under £10m per km and offered passengers their own door-to-door pod service.
- The light rail line in Montpellier cost **21.8m Euros per km**
  - A PRT system would have cost between 5.6m and 9m Euros per km (EDICT 2004 figures)
- The Oakland Airport Connector, in San Francisco, California, a transport system that's been proposed since the 1970's, and due to begin building soon, has been costed at **£32m per km**
  - Estimated cost of £6-8m per km if built as a PRT system.

With wide range of revenue streams

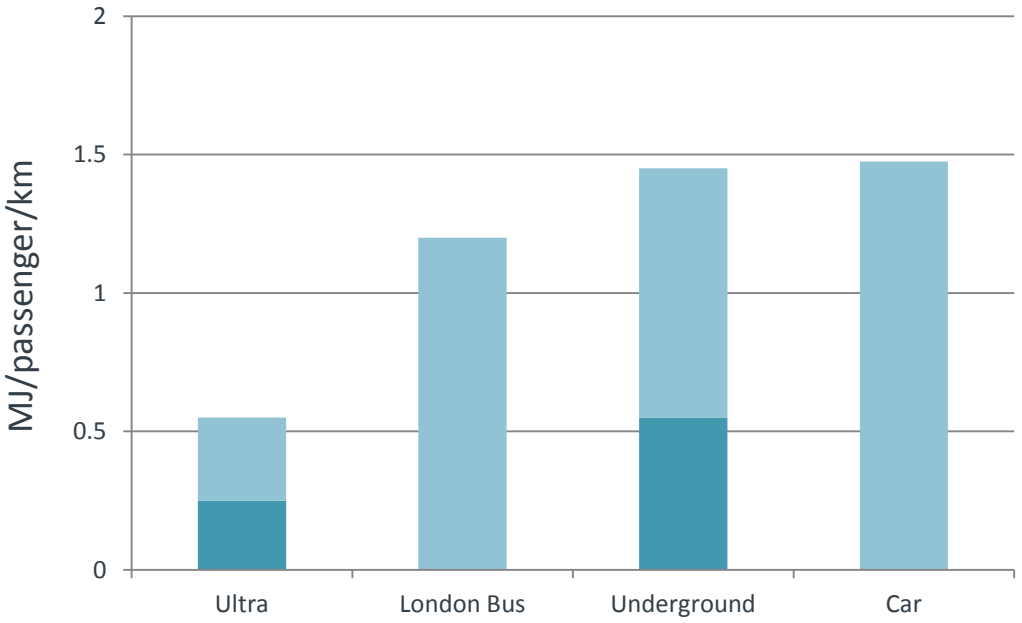
- Land-use savings, combined with increased land values and accessibility;
- Farebox revenue
- No disruption of (airport) services during installation and testing;
- Increased office rents;
- Reduction in traffic congestion (emissions & road wear);
- Passenger travel-time savings & way finding benefits;
- Increased staff productivity;
- Sponsorship & advertising;
- Third party partnerships (e.g. hotel user access);
- Operational savings;
- Low CapEx (vs. APMs) – reduced interest payments.

About Ultra

1. **Pods:** Small, fully automated, battery-powered electric vehicles, with zero on-site emissions.
2. **Infrastructure:** Light, flexible & aesthetic guideways and stations are lower cost & can be routed where needed
3. **Control system:** You don't wait for vehicles – vehicles wait for you. No transfers, no routes to memorize.

Proven operation: Experienced team at Heathrow pod delivering >99% levels of availability during first year of public service.

Energy Efficiency



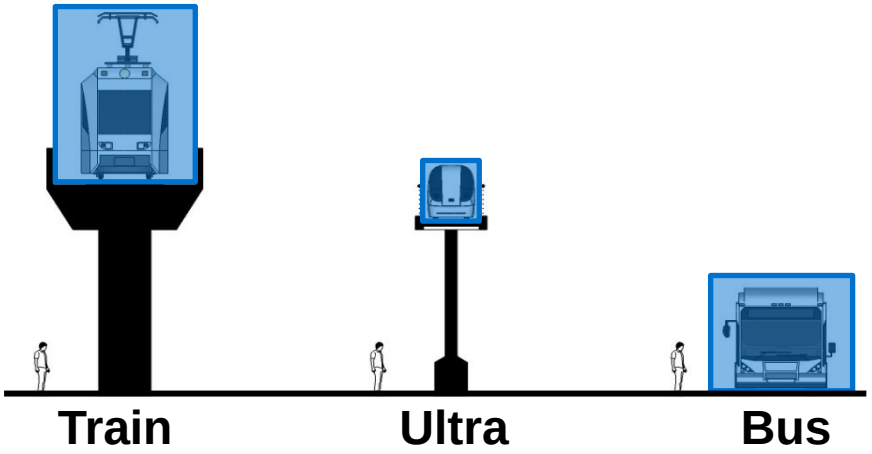
- Light-weight electric vehicles
- Only move when there is user demand
- Avoid ‘stop & go’ waste
- No on-site emissions
- Low external noise

UK Data. Assumptions:

- Average passenger loads
- Well to wheel (darker shading - direct electricity use only)

70% carbon benefit over car transport
50% carbon benefit over train/bus

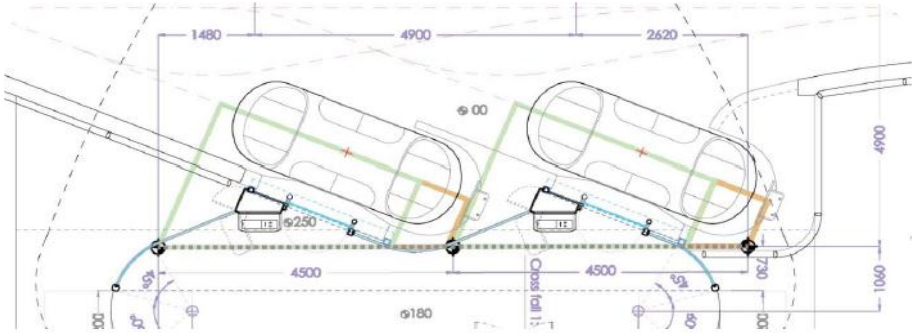
Lightweight, Versatile Infrastructure



- Elevated guideway takes up far less space than other forms of transit.
- Lightweight, silent, zero-emission vehicles can be run inside buildings.
- Station and guideway design can be customised to fit the site.

Flexible, efficient & low cost design

- Non-captive vehicle with tight cornering ability allows efficient stations & flexible routing options.
- In addition, PRT provides a transit capacity (fleet size) better matched to expected demand levels.
- This combines to makes the system very cheap to install compared to larger-vehicle systems with much heavier, less flexible infrastructure.

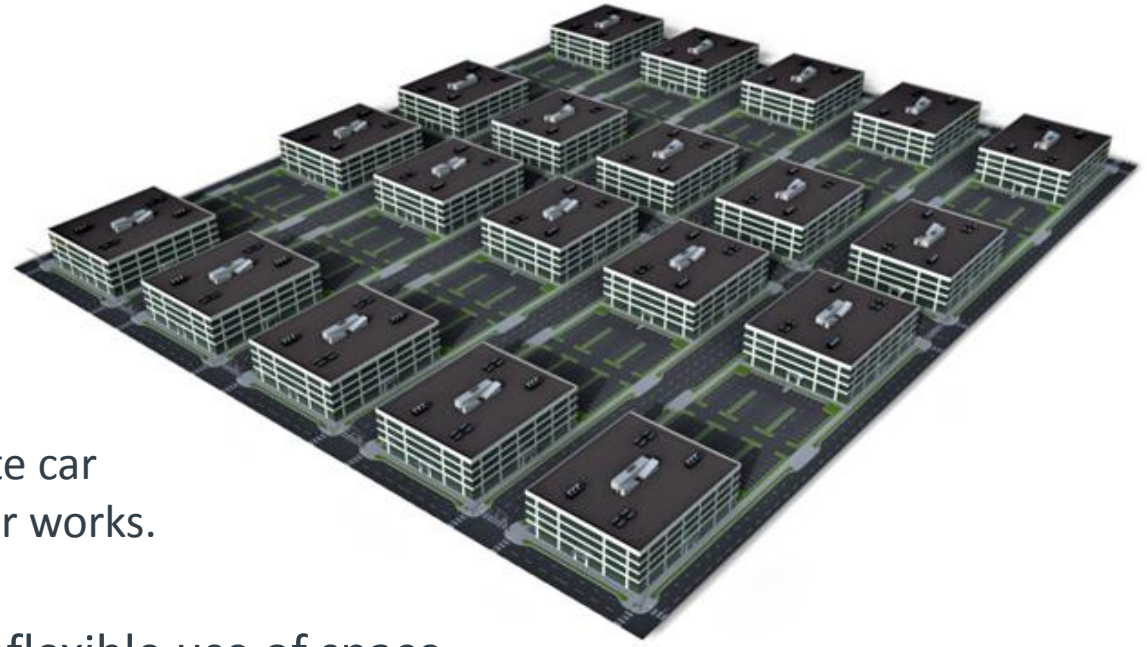


Snow & Ice Clearance

- Motto: “Open when adjacent road impassible”
- Successful 07/08 Engineering Tests in Denver (61” pa)
    - 2 additional heavy weather Engineering Test winters planned
- GRP grid running surface
    - Crossing members offset 4” below GRP, so GRP not occluded
- Snow:
    - Dry snow falls thru the guideway
    - Wet snow is brushed thru guideway
- Ice:
    - Minimal application of “benign,” non-corrosive de-icing fluid, works to -15C
    - May need to collect fluid via drainage
    - Vehicles flex GRP, breaking ice
    - Option: blow hot air on GRP using a special vehicle
- Control system monitors wheel slip
    - If slip, reduce speed until remedied.

Land use savings with PRT

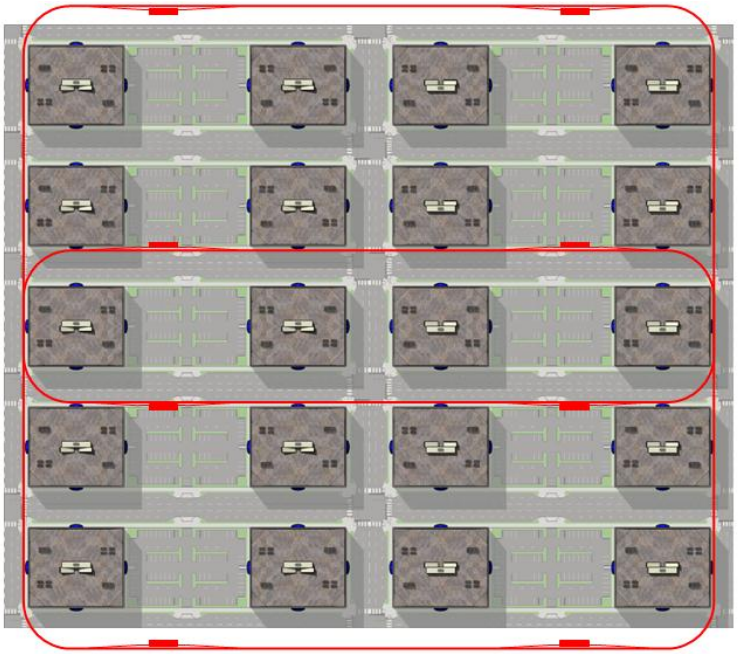
- Consider a typical office park development with twenty buildings:
- Key Points:
  - Car park spaces adjacent to every building.
  - Access & connectivity requires road network within site.
  - No ability to increase on-site car park capacity without major works.

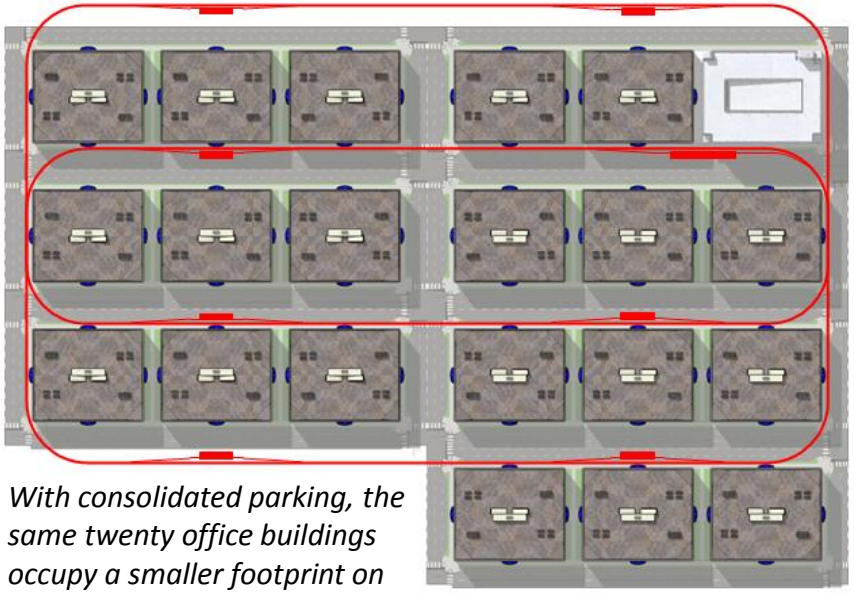


- Result is an inefficient and inflexible use of space.

Land use savings with PRT

- Retrofitting PRT adds flexibility, as the buildings and car parks are more interconnected (see left), and by consolidating parking to a single structure a more efficient use of space across the site is achieved:

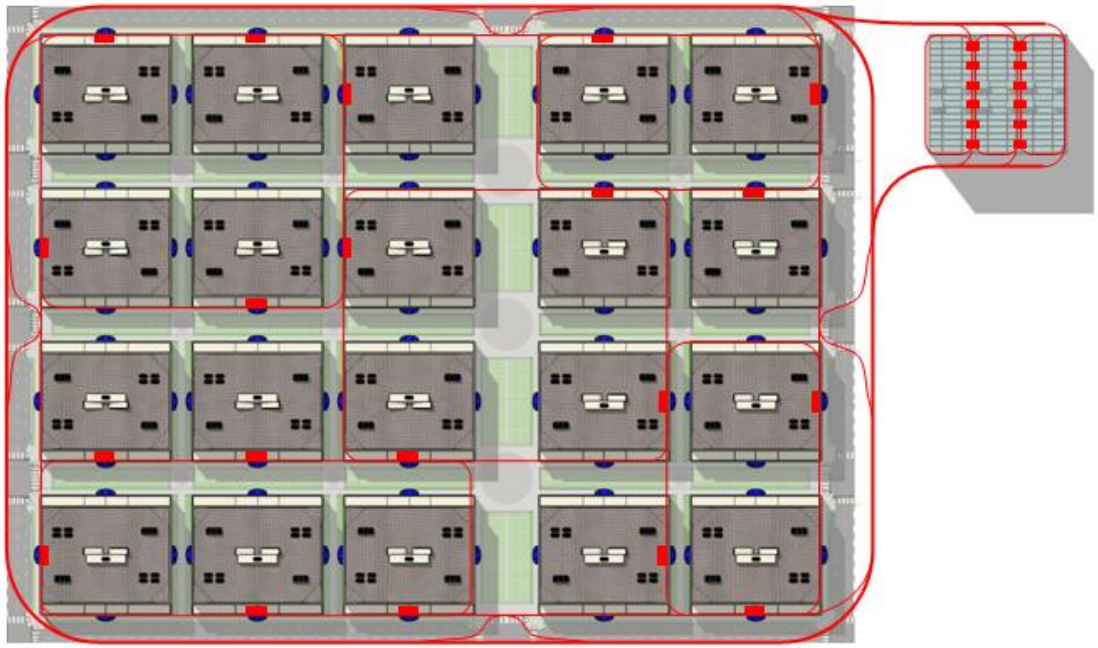




With consolidated parking, the same twenty office buildings occupy a smaller footprint on the site (above).

Land use savings with PRT

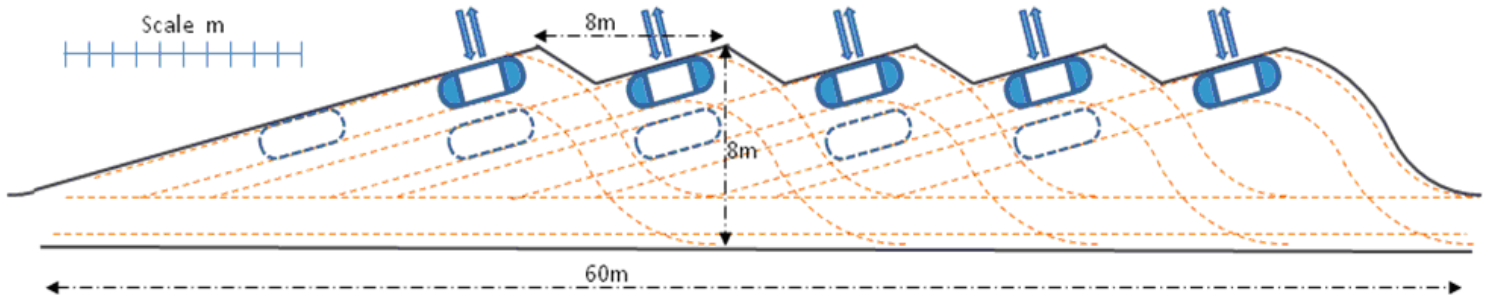
- With a fully integrated PRT system, the road network is no longer required:
- Key Points:
  - Huge land savings: on site area required reduced by 40% (for twenty building example)
  - Door-to-door PRT service provides access & connectivity.
  - Flexibility to increase parking capacity as required enabled by use of off-site parking.



- Result is a highly efficient and flexible use of space.

Station dispatch capacity

- The scheduled nature of conventional mass transit (rail/bus) creates large groups of passengers. Therefore, PRT stations at modal interchanges must be appropriately sized to deal with these larger groups.
- An example of a high capacity PRT station which dispatches a group of 400 people in ten minutes is shown below:



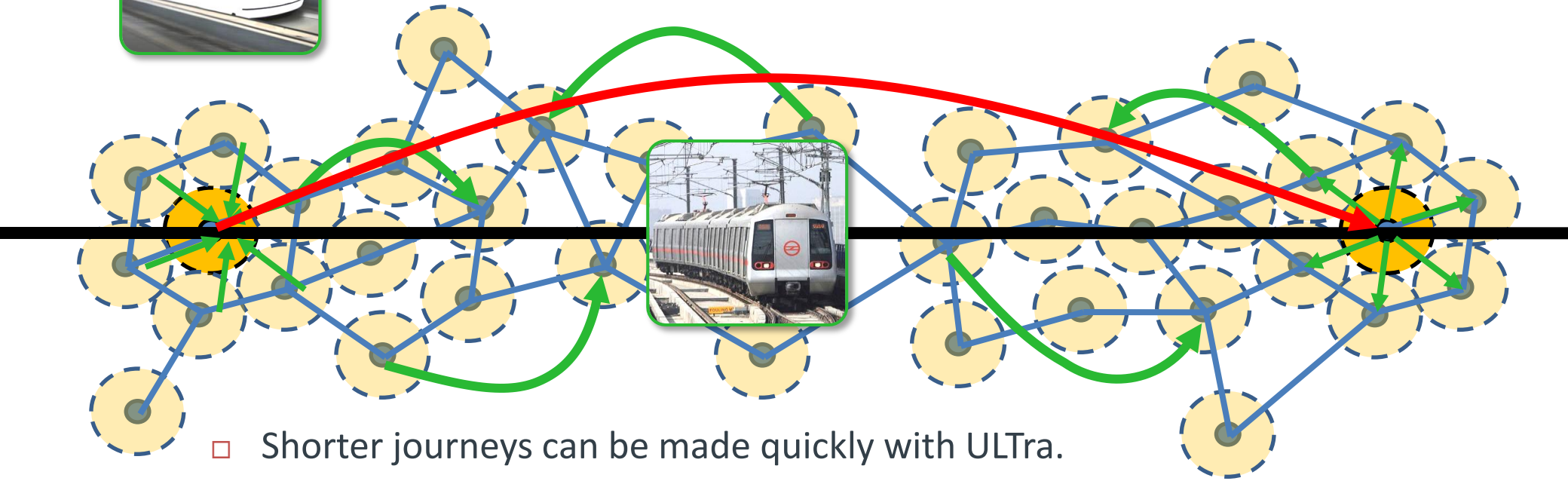
- Given the length of many rail platforms, the PRT station may also be split into multiple smaller stations to locate bays conveniently for passengers.

Queue clearance – PRT vs. Bus

- The station above dispatches a vehicle from each bay every 30s.
- With a four person vehicle, the maximum demand that can be served is then 2400 passengers per hour, which corresponds to one passenger launched every 1.5 seconds, or clearance of a 50 person group in 1 minute 15 seconds.
- Reference passenger service times for buses are 2.5 - 4.2s, which implies a time of >2 minutes for a 50 person group.

PRT stations with this dispatch rate would clear a crowd usefully quicker than would a conventional bus.

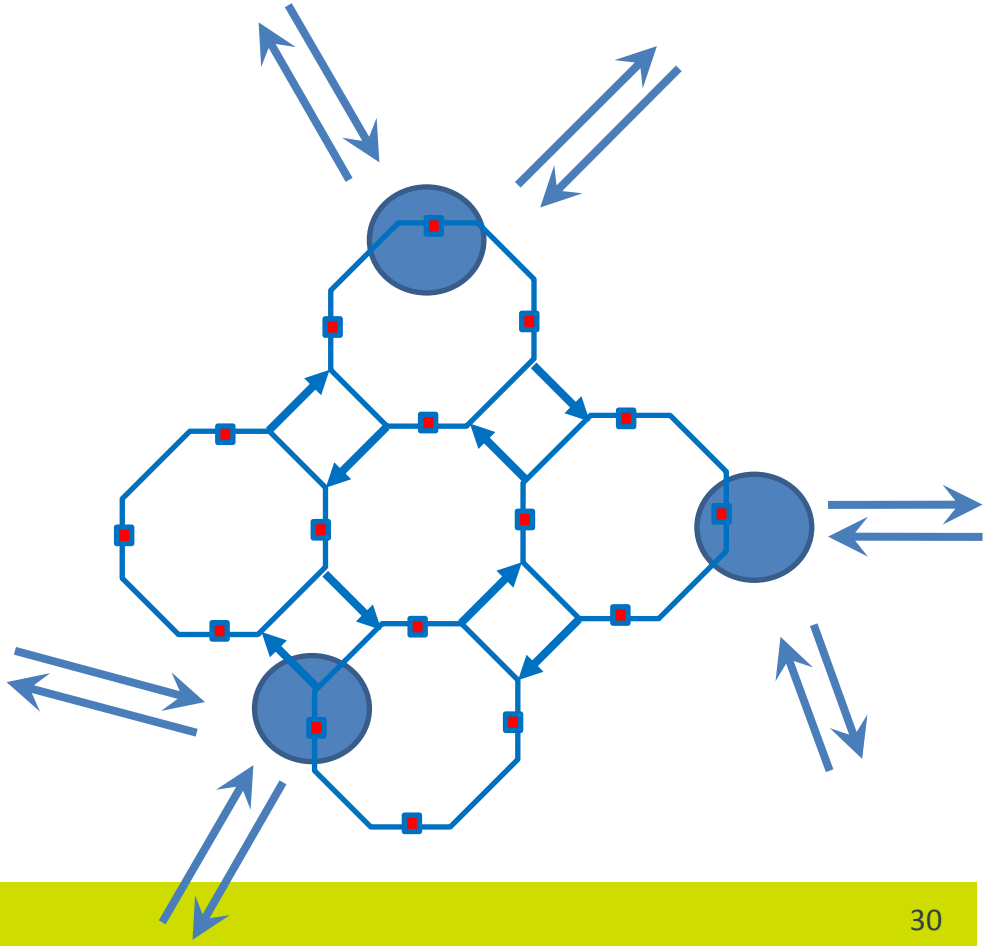
Application: **Ultra** as a feeder into high-speed mass rapid transit



- Shorter journeys can be made quickly with ULTra.
- Longer journeys can be made quickly with MRT.
- High capacity PRT station at modal interchange points ensures rapid dispersal of passengers from MRT.

PRT to Support Transport Hubs

- PRT network connects transport hubs to major locations in City centre
- Transport hubs service
  - Rail
  - Buses
  - Park and Ride
  - Rental Cars
  - Taxis
- A new opportunity for an integrated, intelligent transport system



"*Isn't it nice to find transport which is waiting for you rather than you waiting for it*"
Russell Goodway, Lord Mayor of Cardiff

"*The ideal transit technology is PRT: a) stations right where you are, within walking distance, b) no waiting*."
Peter Calthorpe

"*If ULTra is as successful as I think it will be, this could be a big breakthrough in developing new kinds of totally personalised rapid transit, which could transform our cities in ways that we can't yet see.*"
Sir Peter Hall

"*Fabulous idea*" "*Makes life a lot better*" "*Superb*"
Comments from passengers at trials

"*A great British invention*"
David Metz, Chief Scientist at DfT

"*Ultra is important to the UK*"
Brian Collins, Chief Scientist at DfT

"*You have built a first class exemplar of what an autonomous transport system can achieve*"
Lord Alec Broers

"This is amazing — a well engineered, ready-to-go public transit system that can solve many urban transport problems […] I am going back to tell my colleagues that they must come and see ULTra."
Representative from a major transport agency

"*The ULTra PRT system is clearly leading the world in this exciting and innovative technology*"
CEO of BAA

The Sunday Times

20 proven ways to save the earth

Tackling climate change may be daunting but it is entirely feasible using existing technology

The world's largest solar power energy plant, Sanlucar la Mayor, Spain

World's first floating offshore wind turbine

November 29, 2009

http://www.timesonline.co.uk/tol/news/environment/article6931775.ece

The world's first Personal Rapid Transit (PRT) System, Heathrow Airport

Eco aircraft with unducted fan engines

Tidal Power Station, La Rance, Brittany, France

PRT Industry: Current Position

- Three established suppliers:

  Vectus, 2getthere, ULTra

- Carrying passengers full time in the MASDAR Eco City in Abu Dhabi (2getthere) and at London's Heathrow Airport (ULTra)

- A new component in the transport mix

Ultra – from concept to operation

1995 Founded, University of Bristol
1999 UK Dept of Trade: Grant to build prototype
2000 Winner UK DOT Innovation Competition
2002 Test track launch. Deputy Mayor for Environment
2002 European Union: EDICT PRT study
2003 First safety clearance - UK Rail Inspectorate
2003 BAA transport study: PRT bests APM and bus
2005 ULTra wins BAA PRT vendor competition
2005 BAA invests in ULTra
2009 Heathrow Topping out ceremony, operational testing begins
2010 Commissioning trials with passengers
2012 Open for full passenger service

Engineering & Operational Expertise

System Engineering
- Requirements capture
- System layout
- Simulation and optimisation
- Subsystem specification – guideway, comms, vehicle, CCTV, Control system, AVP etc.
- Integration, test and commissioning

System Control
- Central control system design, development and implementation
- Control algorithm development

Vehicle Control and Integration
- Vehicle control system design, development and implementation
- Vehicle electrical systems integration

System Safety
- Quantified Risk Assessment
- Safety function design
- Safety case development

System Operation
- From planning and set-up through recruitment, training, testing, go-live, and post live reviews and audits

Key role: enhancing public transport

Independent studies by Arup and ITS Leeds show significant benefits to existing bus & rail services when they are supported by an on-demand PRT network.

- Cardiff (UK): A PRT system covering the last 2km to the Bay area would increase patronage by >100% on existing bus & rail services.
- Gateshead (UK): a 21km PRT network serving the inner city would increase the use of rail travel by 168% in the peak and 232% in the off-peak.