

Implementing Automated Transit Network Solutions, Principal Considerations



Introduction

Automated Transit Networks (ATN) offer a number of advantages over conventional automated people movers (APM), light rail trains (LRT) and other mass transit modes.

All systems developed by the three main original equipment manufacturers, Ultra Global PRT, 2getthere and Vectus, provide benefits which are common across applications and land uses. There are also risks, concerns and barriers which are common to all systems.

This note discusses the key benefits and obstacles common to all ATN systems and examines the specific case for four different applications; an urban regeneration project, an airport, a campus style estate and a legacy park project.

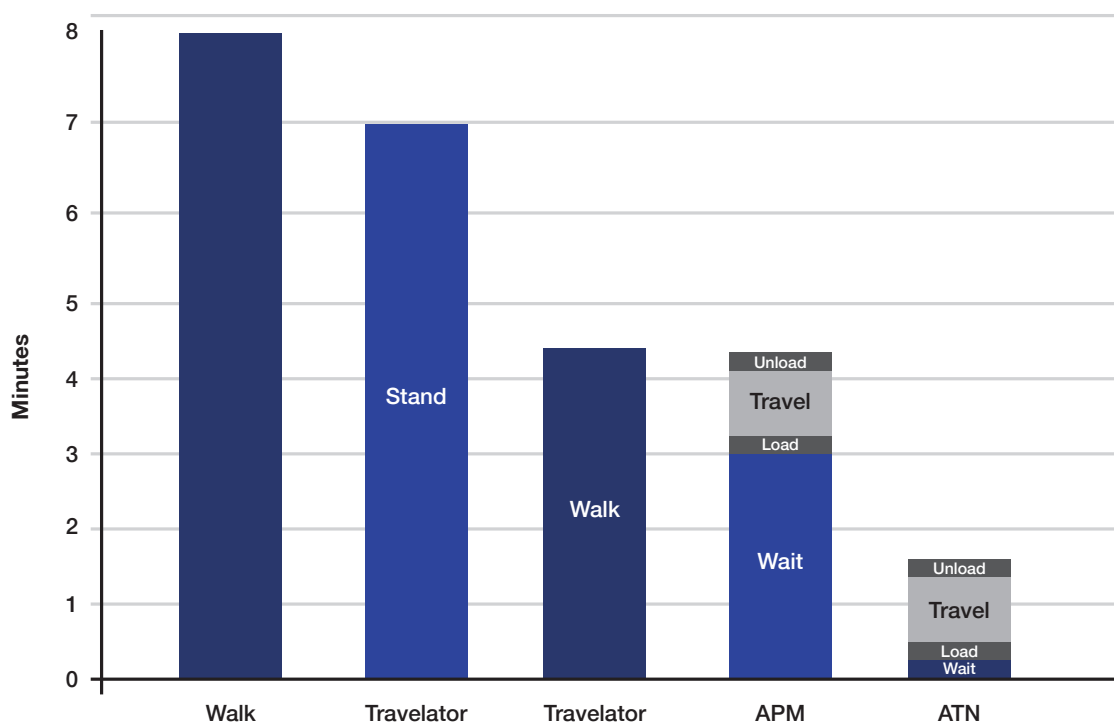
“This innovative system forms part of BAA’s plan to transform Heathrow... It offers a completely new form of public transport – one that will deliver a fast, efficient service to passengers and bring considerable environmental benefits.”

Max Vialou-Clark, Heathrow commercial director

Introduction

On-Demand, Direct Service

ATN systems all offer on-demand transport which provides a non-stop, direct transfer to your destination. The result is a considerable potential saving in total journey times in comparison with other modes.



The benefits of a journey time saving can manifest themselves in a number of ways:

- Perceived distance to rail stations, airports and business districts is theoretically reduced resulting in increased land values.
- Efficiency savings for businesses.
- Modal shift from the private car to ATN, with associated air quality and congestion benefits.

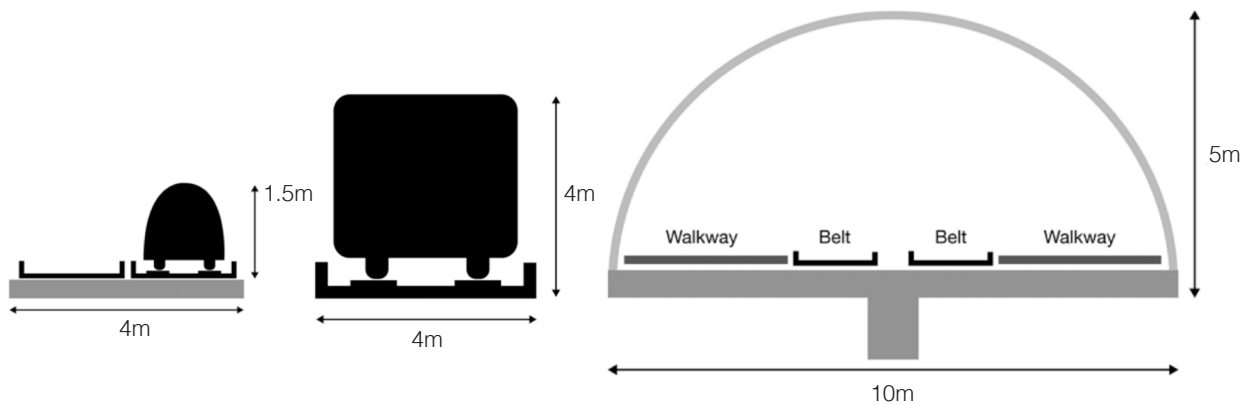
In addition to improved journey times ATN also offers better journey time reliability due to a known number of stops and dedicated guideway.

Operational Corridor and Weight

With smaller, lighter vehicles, ATN is able to operate in narrower corridors than other mass transit modes and the infrastructure is less intrusive. The vehicles are able to negotiate tighter radii and steeper gradients than many comparable modes and this allows routes to be facilitated around constraints.

“Isn’t it nice to find transport which is waiting for you, rather than you waiting for it?”

Russell Goodway, Lord Mayor of Cardiff



Comparison of vehicle and guideway: ATN, APM/LRT, Airport traveller

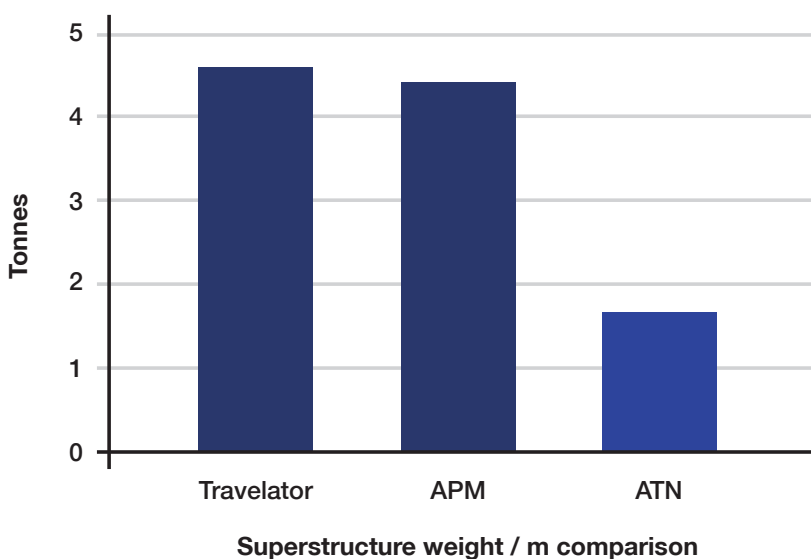
The benefits to project proponents include:

- ATN is able to access areas which traditional public transport cannot reach, opening up new development opportunities.
- Infrastructure is less costly, less intrusive and less environmentally damaging than heavy/light rail or elevated highways.
- The vehicles are more energy efficient due to their lightweight design, non-stop travel and reduced empty vehicle movements.

Operational Costs

In high wage economies, a considerable proportion of operational cost relates to the driver and employment taxation. As an automated vehicle technology, ATN requires no driver, with operations managed by a small team located in a control room.

Furthermore automated systems provide security against local labour market conditions as well as opportunities to control vehicle performance for optimum efficiency.



“A lot of times, people don’t know what they want until you show it to them”

Steve Jobs, Apple



ATN at Masdar City, UAE © 2getthere



GRT at business park Rivium, Holland © 2getthere

Resistance to ATN

The theoretical case for ATN is, in many ways, proven – and the currently operational ATN systems have provided invaluable data regarding reliability and passenger satisfaction. Despite this there is resistance in the market to ATN related to a number of areas:

- The technology is perceived to be less mature and risky compared with more traditional mass transit modes. The technology risk is being reduced as more systems provide reliability data.
- No ATN systems currently operate using a fare based system. Revenue collection is therefore not well understood, which raises concerns regarding payback and revenues. The Morgantown Group Rapid Transit (GRT) at West Virginia University operates with many similarities to modern ATN and has operated as a fare based system for over 35 years. Despite this experience revenue collection, particularly in a urban environment is not well understood, which raises concerns regarding payback and revenues.
- The three OEMs (Original Equipment Manufacturers) are system specific and not interchangeable. There is a perceived risk and caution against “backing the wrong horse” and

ending up with a system without servicing and software support.

- The procurement and operational regime is not established. Who invests the capital? Who is responsible for operating the system? A turnkey style approach delivered through a consortium set-out to construct and operate the system is likely to reduce risks to investors and such an approach should be explored for ATN systems.
- Concerns relate to the practical capacity of systems which are dependent on vehicle size, occupancy and headway. This is of particular concern where systems are required to transport a high peak demand, for example the departure peak from an arena or stadium.
- In most countries there are regulatory obstacles to overcome prior to the operation of ATN, and these can be complicated by the technology falling between rail and highway regulatory environments.
- ATN system costing is relatively immature in comparison to other mass transit modes and there is a lack of suitably qualified practitioners. This contributes to perceived financial risk.

Urban Regeneration

Introduction

Many cities can benefit from the development of post-industrial or brownfield areas in close proximity to urban centres. These old industrial quarters are often characterised by difficult access and unattractive landscapes often alongside disused canal routes, railways and ports. These areas are typically located in the inner city and offer significant opportunities for sustainable travel due to their proximity to urban centres and public transport hubs.

These urban regeneration sites offer a “blank canvas” with few constraints and opportunities to integrate the movement of goods and people, including ATN into the masterplan at the earliest opportunity.

Urban Regeneration

Specific Opportunities

Integration of ATN into the masterplan offers a wide range of potential benefits and opportunities including:

- A reduction in the amount of land dedicated for highways and car parking should present opportunities to increase developmental value through either an increased quantum of development or better quality urban realm and public amenity space – resulting in higher land values.
- Analysis from a number of sources indicates a direct link between land values and perceived access to rail stations. This research indicates that a land value uplift of between 10% and 30% would be expected where land is perceived to be adjacent to a railway station. Data from the Heathrow T5 ATN system also shows that, in terms of accessibility and utility, passengers perceive little difference between parking direct at the terminal and parking at the business car park with transfer by ATN. ATN therefore provides a means of increasing land values by changing the perceived distance to railway stations and other assets.
- Remote parking and servicing can facilitate a better land-use mix within the heart of the development, with this potentially designed to manage peak hour flows with consideration for ATN capacity.
- Peripheral at-grade or multi-storey car parks (MSCP) would likely be significantly less expensive than the construction of basement car parks underneath buildings.
- ATN could open up new areas to be developed as the alignment permits tighter radii and steeper gradients than many alternatives, including light rail, highway and bus lanes. In certain sites ATN could be the only means of providing motorised transit into a development site.
- ATN could in itself prove a differentiator for the development - particularly where it is aligned with other benefits (e.g. links to a major rail station or airport, or car free development). This can help provide a “wow” factor enticing investment.
- The costs of ATN could be significantly reduced by spanning the guideway between buildings or cantilevering the guideway from building structures. Stations, control rooms and depots can be integrated into buildings reducing costs.
- ATN can provide a “last mile” connection between mass transit systems and the end destination. By improving the feeder network the user experience and effective catchment of mass transit systems there should be increased ridership and revenues.

For different occupiers there are different benefits:

- **Residents** benefit from car-free access via a system which provides shorter journey times and longer operating hours than conventional public transport. Where ATN is integrated into a wider system it could facilitate a low carbon environment with enhanced public realm, noise and air quality. However, it is unclear if the market is prepared to pay a premium for such benefits. Experience from Masdar indicates that in some cultures and environments the premium is placed on car parking adjacent to their residence.
- **Businesses** benefit from better access to the market and more reliable journey times compared to car/public transport alternatives. Opportunities to directly and securely link groups working in different locations through use of ATN as a “horizontal elevator”. ATN provides a means of efficiently transporting people from workplace to workplace encouraging face-to-face meetings and the exchange of thoughts and ideas within organisations and across multiple companies located in the same locality.
- **Retailers** could benefit from Just in Time (JiT) deliveries and consolidation of loads using an ATN based system could increase shop floor sizes by reducing storage area requirements. There would be opportunities to advertise on and within ATN Pods. ATN destination could be selected by the retailer you want to visit, the sector, or even specific items – all searched for via the interactive screen.



Illustration of sensitive ATN guideway treatment: Bath design competition © Arup

Specific Constraints

Potential constraints could include:

- Physical constraints such as retained buildings, topography, existing utilities which are being retained, major landscape features, points of access to the regeneration area.
- Planning constraints relating to redevelopment in a protected area (central Rome - UNESCO World Heritage Site), protected buildings or protected sight lines (i.e. views across London from certain parks). There are ways around such constraints and means of integrating ATN into protected areas, with some examples developed in response to an ATRA competition for the integration of ATN into the centre of Bath, UK – a UNESCO World Heritage Site.
- A lack of awareness and understanding in the wider planning community – including masterplanners, transport consultants, developers, financiers and government organisations. Many are unaware of ATN technologies and thus it is not considered at any stage of the process. Furthermore, where ATN is given consideration a lack of understanding can contribute to misconceptions regarding applications, capacities, risks and costs. More needs to be done to increase the awareness of ATN and to further basic understanding of the technology, the potential benefits and the issues to be overcome.
- Return on investment – the return for developers investing in ATN is poorly understood. Will land values increase? Does an increase in developmental land result? The potential “savings” in operational costs such as driver salaries are unlikely to be of benefit to commercial investors.
- How is revenue collected to fund operation/ capital repayment? Where a fare mechanism is required it places additional cost and complexity on the system and the user experience is not comparable to typical alternatives (walking routes, pedestrian subways, travellers, shuttle buses). Where links are provided to remote car parking ATN “fares” can be generated as part of parking charges. It would also be possible for operation of an ATN network to be paid for via building service charges, which are a common means of funding vertical transportation systems (i.e. elevators).
- How are increases in land value captured by the market? For private developers there should be links between investment in ATN and higher property values but this needs to manifest itself in higher rental/sales values. If local authorities are to invest, is the increased local tax take sufficient to provide a rate of return on investment?
- Reduced street activity with fewer walking and cycling trips between destinations and public transport hubs / car parks. This could impact on urban vitality, particularly passing trade for retailers.

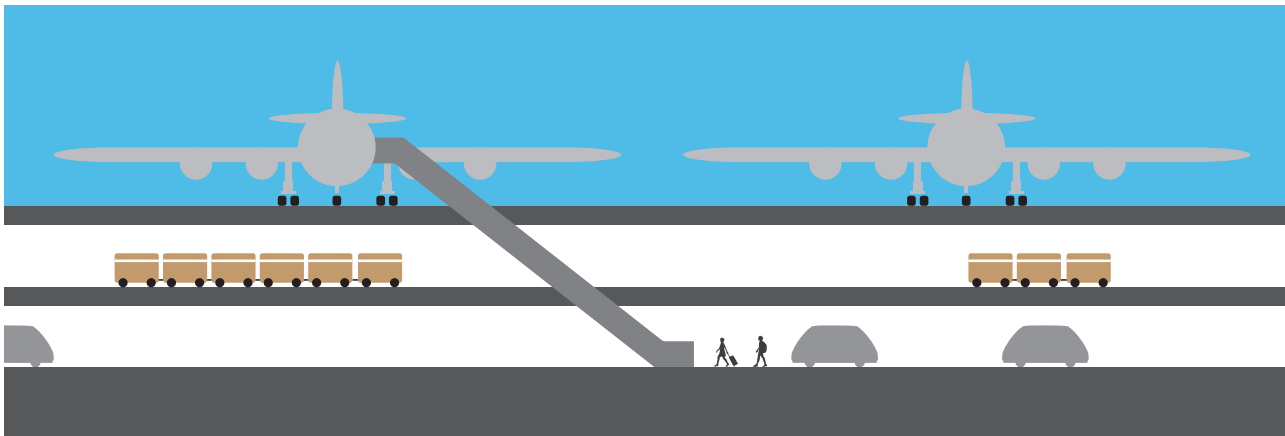
Airport

Introduction

Airports are one of the areas where there is an existing ATN system operating successfully as a demonstration case – the Heathrow Terminal 5 ATN system which uses the Ultra technology.

Airports rely on the efficient transfer of people, luggage and goods and there are a number of potential applications for ATN:

- Connectivity to remote car parks – replacing shuttle buses which can be more costly to operate and provide a lesser passenger experience.
 - Links with remote rail/bus stations or car rental facilities – which are typically made through subways with travellers (Heathrow), shuttle bus services (Barcelona) and APM systems (Tampa).
 - Transfer between terminals which are usually done via subway pedestrian and traveller links (Heathrow Terminals 1-3), APM systems (Orlando, Beijing, Rome, Atlanta) or underground rail (Heathrow Terminals 4 and 5).
 - Transfer to remote aircraft via underground ATN system. Such a system would replace traditional transfer bus operations.
 - Connections to remote gates, replacing travellers and long walking distances (e.g. Amsterdam, Paris).
 - Baggage/goods transfer replacing trolley trains.
 - Automated JiT deliveries to retail units from remote consolidation centres (Heathrow and Schiphol consolidation centre currently use HGVs).
 - Direct connections to residential areas (staff accommodation) and trade zones i.e. “Airport cities”.
- There are a number of opportunities and constraints associated with airport environments, some of which are specific to the type of application ATN is used in.



Underground ATN transferring baggage and passengers to remote stands © Arup

Airport Specific Opportunities

Opportunities:

- ATN is particularly suited for connecting to remote car parking as transfer services are required over a number of hours, to dispersed locations and with low/medium demand.
- A single operating authority is typically responsible for buildings, infrastructure and land ownership reducing planning time and risk.
- Time critical environment where passengers are likely to value journey time savings. Journey comfort and surroundings are also more likely to be valued by airport passengers than traditional mass transit ridership. The ability to provide different service levels to different customers would have value to an airport operator.
- ATN transfers could reduce walking and waiting times, giving passengers more time for shopping and dining. A terminal based around ATN stations for transfer could potentially better integrate retail and waiting areas.
- Opportunities for passengers to check-in as part of their transfer through links between in pod and airline systems.
- Opportunities for passengers to select areas of the airport which they wish to visit – for example food court, retail areas, lounges, hotels or baggage drop-off.

Airport Specific Constraints

Constraints:

- High point-to-point demand for certain applications e.g. terminal transfer, which can be less suited to certain ATN configurations. While a large ATN network comprising of multiple stations would be able to deliver vehicles in response to demand a constraint is likely to be

the availability of space to accommodate the required number of stations.

- Security concerns could preclude the use of ATN systems for certain applications for example any trips involving landside-airside transfer, unless security screening can be built into the pre-boarding process.
- Airports derive significant revenues from retail concessions and car parking. Where ATN is used to connect public transport facilities there could be a reduction in demand for car parking.
- As a direct form of transport, if ATN were to be introduced for transfer to aircraft or between terminals it could lessen the number of passengers visiting retail outlets – for example those located along traveller corridors at Amsterdam. It is also feasible that, with reduced journey times and greater journey certainty, passengers would arrive later for flights, spending less time in the terminal.
- Research at Heathrow T5 indicates that the ATN system achieves significantly higher passenger satisfaction scores than the bus system it replaced and data suggests this should result in a higher spend per passenger at concessions. It is unclear if airlines receive any benefit in terms of additional passenger satisfaction ratings and thus the link between ATN investment and return is less clear for the airlines.
- Airport growth is principally occurring in the Gulf and Asian markets where labour costs could make the “driverless” benefit of ATN of less value than in high-wage economies.
- Where established airports are undergoing refurbishment, opportunities for integration of ATN are often constrained due to existing infrastructure (e.g. Heathrow Terminal 2).

Campuses and Business Parks

Introduction

Campuses and business parks comprise of a collection of buildings typically occupied by a particular land use (retail, office) or a single organisation (hospitals, education providers, major employers, military establishments).

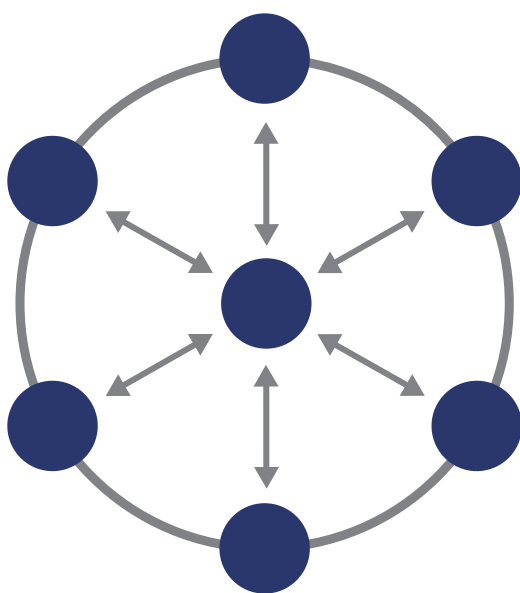
These sites are typically located close to major highway and/or rail interchanges and ATN could provide a valuable “last mile” connection replacing walking or shuttle buses.

A further consideration is leisure and recreational parks. This could include more intensive land uses, such as theme parks e.g. Disney Land, Universal Studios, or National Parks and wildlife attractions e.g. Yosemite. For theme parks monorails are often used as a means of connecting to remote parking or travel between zones, while for National Parks a network of shuttle buses is often used to transfer visitors to the main attractions.

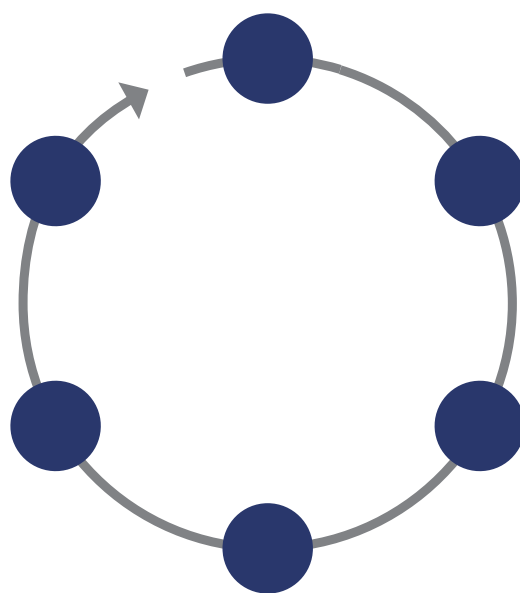
Campus Specific Opportunities

In campus style layouts ATN would function as a “horizontal elevator” linking buildings much as an elevator links floors on a building. Opportunities would include:

- Sufficient space is likely to be available to integrate ATN into the existing campus environment.
 - Dispersed demand across a wide geographical area which can, depending on site layout, be much more suited to an ATN network than shuttle buses. For example a “hub and spoke” style operation would be much more suited to ATN than a linear or orbital layout – which would facilitate buses/APM. For major business parks there could be a significant time saving for passengers and cost saving to operators facilitated by a switch from shuttle buses to ATN.
 - ATN could be used to connect remote car parks to central areas, creating a car free local environment. Such an approach has been adopted by Masdar, UAE.
- ATN could be used to provide restricted access to certain areas, with key codes/passwords required to select certain buildings/areas. This is a benefit when compared to shuttle buses or transfer on foot, where security clearance would need to be checked prior to building access.
 - The spread of buildings means that campuses are typically not infrastructure intensive areas and integration of ATN is therefore simpler and more cost effective. There could be opportunities to run ATN at-grade reducing costs and creating car free environments (with benefits for hospitals, universities etc).
 - Automated point-to-point transfer of equipment/patients between buildings using ATN pods.
 - In many applications the developer is likely to be the end occupier and benefits such as reduced operational costs and improved transfer efficiency are therefore of direct benefit to the party funding ATN.



Hub and Spoke



Orbital



GRT at business park Rivium, Holland © 2getthere

- Direct links to major public transport hubs such as railway stations and airports (NEC for example) – although consideration would need to be given to passenger demand. The Rivium business park in Rotterdam has adopted such an approach with a fleet of automated shuttle buses linking the business park to a metro station.
- Attaching an ATN station directly to an upper floor of a building opposite the elevator bank would connect the building to other such buildings just as different floors are connected to each other by elevators. The potential to link separate buildings on a corporate campus and facilitate face-to-face meetings could be invaluable to large corporations.

Campus Specific Constraints

- Larger flows may not be effectively dealt with, for example PM peak hour departures from commercial or research establishments, or end of lectures at a university.
- Campus developments are less typically spatially intensive and can be located in areas with lower land values. The potential masterplanning benefits of ATN in terms of spatial efficiency could therefore be of less importance than in higher value, intensively used areas.
- With the exception of parking charges (where ATN access is linked to remote parking) there is unlikely to be a method for directly generating revenues from the ATN system. The revenues must therefore be derived through efficiency/operational savings or by fare charging.



Legacy Parks

Legacy parks, resulting from the hosting of major events, have become an established model for development and regeneration of large areas, as exemplified by the London 2012 Olympics which was a catalyst for the regeneration of Stratford.

With regards to opportunities and constraints, legacy parks have much in common with urban regeneration areas and campuses, however there are some additional considerations:

In the short-term the ATN system could play an important role in the successful delivery of the “event”. This could be in a number of roles depending on the event in question – connections to car parking/ public transport hubs, transport around the event, VIP transport. In considering ATN the number of potential passengers and the type of journey will need to be considered. For example a dispersed event such as an EXPO or Garden festival is likely to work better than a major stadium.

Given the relative rarity of ATN systems it could act as an attraction in its own right – contributing to the success of the event. This would work particularly well if there were synergy between the type of event and ATN – e.g. an EXPO or technology themed event.

Post-event the presence of a fully functioning transport system is likely to be a benefit with respect to attracting investment.

One constraint and issue relating to legacy parks is that after the event, the capacity required for any transport system could be much lower than during the event. As such there is likely to be an excess of fleet vehicles after the event has ended unless the future land uses provide similar peak demands.

With ATN this could be less of an issue than with LRT or monorail systems, with the light weight pods relatively cost effective to transfer to another location.

For further information please contact:

ATRA Industry Group

David Holdcroft

e david.holdcroft@gmail.com

Advanced Transit Organisation

Stanley Young

e seyoung.umd@gmail.com

www.advancedtransit.org

Arup

63 St Thomas Street

Bristol, BS1 6JZ

e austin.smith@arup.com

www.arup.com