

# CHANGING JOURNEYS

The Development of Underground Interchanges



CONSULTATION  
DOCUMENT

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## INTRODUCTION

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Government policy \* recognises that the demand for travel in the UK is increasing and that additional road building alone cannot provide the solution. The current ten-year plan has committed £180 billion to cut congestion and deliver a first class transport system. If this initiative is going to work, motorists need to be persuaded that, where practical, they should switch from cars to public transport for all or part of their journey.

The Department of Environment, Transport and the Regions (DETR) and the Highways Agency have therefore launched a number of initiatives to make public transport more attractive. They have identified the point where people change from one kind of transport to another (called an "inter-modal interchange") as a key area for examination.

One initiative is a study for the Highways Agency called: "Integrated Transport, The Development of Underground Space", carried out during 2000 by Brown & Root Consulting together with YRM Architects, Planners & Designers and Hewdon Consulting. The study looked at the design, in concept, of underground interchanges and used virtual reality computer models to illustrate best practice. The study did not look at the way these interchanges would be connected to public transport systems or whether there would be room for the extra traffic. These are being dealt with by other studies.

This Consultation Document seeks views from potential developers and promoters on the key considerations for a successful underground interchange facility. The graphic images used in this document have been taken from virtual reality models developed during the study.

Comments on the Consultation Document are welcome both generally on the observations and also on specific issues. Details of where to send comments are given at the end of the document.



\* 1998 Government White Paper 'A New Deal for Transport'



## BACKGROUND

*Interchange:- "Any passenger facility where transport services are in sufficiently close proximity that transfer between them, or to another mode, is practicable and cost-effective or could be made so." - (Passenger Interchanges - Chartered Institute of Transport, 1998).*

It is thought likely that a number of new interchanges will be needed to make public transport work effectively, but these must meet the needs of the traveller, the transport operator and overall Government policy. Some of these interchanges would provide connections between different forms of public transport; some may be places where people park their cars and transfer to public transport; yet others may be hybrids.

The design of these interchanges would recognise that people make journeys for different reasons:

- Travel to work –concentrated at peak hours and sensitive to travel time and price.
- Long distance business travel – less concentrated in peak hours and less price sensitive.
- Leisure – less concentrated but convenience dependent and can be price sensitive

Whilst we have conventionally built such interchanges at the surface, building new interchanges underground could be desirable where one or more of the following apply:

- there is to be a connection to existing underground transport
- environmental considerations or existing buildings rule out surface construction
- surface space is commercially valuable

The CIT UK report on Passenger Interchanges discussed the question of ownership and responsibility for developing or improving interchanges and concluded that this could include public transport operators, local authorities, Railtrack, passenger transport executives, regional development agencies and individual developers or development consortia. The report also noted that whilst improvements to interchanges might increase the overall appeal of public transport, the contribution to modal shift (i.e. people changing from cars to public transport) by interchanges alone should not be over-estimated.

As well as passenger interchanges, there may also be a need for new freight interchanges.

## WHAT MAKES A SUCCESSFUL SCHEME FOR PASSENGERS



To succeed, interchanges have to improve passengers' journeys in terms of cost, time, convenience and reliability. Transport Planners use sophisticated computer programs to model these factors logically, putting a price on:

- time taken, including waiting (which most people find disagreeable),
- direct costs of transport (including extras, like parking), and
- the number of changes of transport mode.

But there are many other aspects which must be right and which are harder to measure.

Interchanges only work if:

- the place looks and feels right,
- it is easy to use, and
- it feels safe.

Different people have different views about interchanges, but some of the essential requirements, as determined by the study, are set out in Boxes 1, 2 and 3.



# The Look & Feel

## The Experience

- A strong sense of arrival and departure, with visual connection between modes of transport would reinforce the experience of using the interchange

## The Environment

- A degree of outside awareness, created by directed daylight, windows or skylights would help orientation
- The use of imaginative artificial lighting would help to provide welcoming environments
- A feeling of security is generated underground by large open spaces, visual interconnection between modes of transport and helpful, attentive staff
- The interchange must be clean and the air fresh
- By its enclosed nature, an underground interchange will be sheltered from wind, rain and cold

## The Building

- Each interchange should have its own identity which would enhance the experience of the visit
- High quality of design and construction would be apparent in the finish and promote confidence in the users
- The use of internal landscaping could be attractive, functional and provide identity. Water features create a calm environment and serve to separate areas without building walls
- Above all, there should be a feeling of space and light, not oppression and claustrophobia

BOX

1

# Ease of Use

## Passenger Perceptions – Ease of Use

### Finding the Way

- Visual links between transport modes help orientation and are preferable to signs
- Public address systems should be high quality with a clear output
- Where signs are used, they need to be simple and clear
- Easy and quick changes between transport modes could encourage use. This would be helped by through ticketing and maps
- Vertical movement (by lifts and escalators) can avoid long walking distances associated with surface car parks

### Organisation and Services

- Ready access, secure parking and no queuing would attract people
- Changes in level confuse passengers. Levels dedicated to a single mode of transport assist orientation
- Baggage handling should be minimised. Transfer of baggage from car to public transport should be simple and direct
- The disabled, the elderly, families, cyclists and people with special needs should be accommodated as equals

### Information

- A lack of information, or incomplete information, causes frustration. Statements about arrivals, departures and delays should be comprehensive and easily understood

BOX 2

# Safety

## Passenger Perceptions – Safety

- Clear open spaces without hidden corners or remote passages would create a feeling of security
- Discretely visible security systems and an appropriate level of visibility of supervisory personnel (someone present to meet and greet travellers) would add to confidence
- Strategies for maintaining security off peak and at night are essential
- CCTV and other technologies provide visual reassurance as well as practical help

BOX 3

## FREIGHT

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As well as interchanges for people, there are interchanges for freight. Historically, there has been a close relationship between the Post Office and the rail industry for the delivery of mail and parcels. A number of rail stations use underground space to handle mail deliveries and the Post Office has its own cross-London underground railway.

It is likely that e-commerce will lead to the restructuring of some industries, with changes in the way they supply and deliver their products leading to greater emphasis on smaller parcels and packages. The rail-freight industry is developing new concepts for delivery of small packages in urban areas, which could provide a significant part of the solution to this new need. These concepts are currently less well developed than their passenger equivalents but should become reality in the next few years.

Where the development of a new urban interchange leads to new houses and offices being built at a greater density, there is also scope to separate delivery and service traffic, concentrating it underground.

The potential for underground interchanges for heavy goods is less easy to see because of the size of interchange required. Surface interchanges for road/rail freight can be as big as 50 hectares or more.





## THE PROMOTER'S VIEW

### Planning Considerations

Before you can think of planning an interchange, you need to be clear that:

- There is enough room in the public transport system to carry the extra passengers
- You can connect the interchange to the transport network at reasonable cost
- The interchange will actually attract passengers
- That building the interchange will help to reduce congestion and not increase it.

In short, the interchange has to be part of an integrated transport solution. The Government has now outlined responsibilities for planning integrated transport. Broadly, airport owners and Railtrack will have the power and responsibility to promote solutions to their own needs, with local authorities responsible for promoting more effective use of light rail, buses, cycling and walking.

There will be a framework of regional and local transport plans, similar to the town-planning

framework, which will enable a consistent long-term approach to issues.

Most importantly, the Government is using Multi-Modal Studies to look at problems in particular areas and to find solutions across a range of transport modes. Any proposals for new interchanges will have to be integrated with the Multi-Modal Studies programme.

Meanwhile, some local authorities have well advanced plans for ideas such as park-and-ride schemes and light rail (tramways).

The Government is also committed to reducing the time taken to implement schemes. The Transport Works Act 1992 eliminated the need for a Parliamentary Bill for rail and canal schemes. There is currently a fundamental review of the laws and procedures relative to compulsory purchase and compensation. This should be followed by a review of the planning and appeal system for large projects

Promoters should feel confident that there is a clear process for gaining approval for interchanges and that sensible proposals would have the support of planning authorities.

## Financing

The Government would like new interchanges to be built using private sector finance, even if support from the public sector may be needed.

Private sector promoters would need to carry out their own appraisals of planning, design and construction, operating costs, income and financing for each scheme.

The cashflow profile of this kind of interchange is similar to many Private Finance Initiative (PFI) or Build, Operate and Transfer (BOT) projects:

- There is an initial construction requirement followed by an operating period.
- The main structure of the interchange is long lasting.
- Life cycle costs and operating costs are relatively predictable.
- Given that the demand for travel will continue to increase, revenue forecasts are the most difficult to predict.

The bulk of the public transport infrastructure in the UK is publicly subsidised, either directly or through subsidies paid to transport providers like train and bus companies. It is therefore likely that these interchanges would be subsidised by the Government in some way and

subject to price regulation. How this happens would depend very much on the kind of interchange and the relationship of the promoter to transport providers. Nonetheless, the government has already laid down clear guidelines about how it will appraise any proposal.\*

\* Department of the Environment, Transport and the Regions - Guidance on the Methodology for Multi-Modal Studies (GOMMS), May 2000

## Design and Construction

Underground interchanges would usually cost more to build than surface interchanges, typically by about three to five times. Major factors that influence the costs of underground construction are:

- Excavation and support – both temporary support during construction and the permanent support required to maintain long term stability underground.
- Mechanical ventilation and enhanced lighting
- Safety system considerations – both during construction and use (for example, evacuation routes in case of fire).

However, the benefits of underground construction can be realised through reduced land take and a better chance of optimum location. The additional costs listed above can be reduced by:

- Adopting partly underground and partly surface designs.
- Using existing excavations (old quarries, natural slopes and cliff faces) to reduce excavations.
- Minimising the facilities required for the interchange - for example, using state of the art automated parking equipment to reduce the areas required for car parks and also computer control to minimise unused parking space.



## Operating Costs

The main operating costs for underground schemes are likely to be similar to those for surface interchanges. There is now a wealth of information about operating costs for interchanges such as airports, bus and train stations, so these should be relatively predictable.

However, costs related to safety systems are inevitably higher underground. Lighting and ventilation, and other electro-mechanical costs are also likely to be higher, not least because these features would need to be state of the art and fully reliable (with back-up units). These additional costs will be weighed against advantages in the reduction in heating and the ability to recycle heat underground.

## Income

There are three main sources of income:

- Car-parking
- Retail and concession income
- Access charges.

## Car parking

Ideally, people would use public transport for the whole of their journey. In practice, some people would want or need to drive to the interchange and park there. The price they pay for parking could be worked out using the traffic model and depends on all kinds of things, such as:



- What it would cost to do the journey from home on public transport
- What it would cost to do the whole journey in a car (including delays)
- How much car parking costs in places near the interchange.
- How much it costs to provide the car parking space

## Retail and concession income

Most new interchanges would work like suburban railway stations - people would pass through very quickly so they probably would not spend very much.

Furthermore, if the interchanges have too many shops, people would start coming

just to do their shopping which would defeat the whole object.

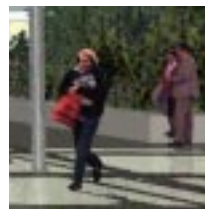
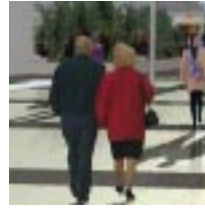
So, while shops and cafes are important to passenger comfort, they may not make a lot of money.



## Access charges

The promoter would also expect to be paid for each passenger that uses the interchange. In theory, the promoter could charge the public transport operator a simple fee per passenger. This fee would be included in the price of a ticket. However, it is not this simple because:

- Each type of transport has its own rules about who can charge what, overseen by a different regulator.
- Most transport in the UK is already subsidised in one form or another by a very complicated system of payments.
- The public transport operator might prefer to pay on a sliding scale according to how much the ticket costs, otherwise people travelling shorter distances are discouraged.
- The Government might prefer the promoter to be paid according to how many vehicle miles are saved, not how many people use the interchange.
- A journey could involve several interchanges, each needing their share of the fare.



Each type of interchange would therefore need its own rules about how an access charge is calculated and how any required subsidy is provided – it could be paid directly from government to promoter or it could be paid to the public transport operator as part of the general regulatory regime.

The good news is that the framework for deciding these issues is already in place and that the Government is committed to making sure that such schemes are pushed forward. It has also published clear guidelines on how it will assess whether schemes are worth subsidising (see Box 6).

# Promoter's Questions

## Promoter's Planning Questions

- Does the transport planning model prediction support the need for the development, and what is the potential passenger growth?
- How does the scheme sit with national, regional and local development plans and multi-modal studies? Is it likely to be embraced and would it attract subsidies? (see box 6)
- What are land values and construction costs in the area, and are there alternate sites and/or construction techniques, which may be more cost effective?
- What are the environmental implications of the development and what effort will be required to mitigate environmental impact
- Is the scheme flexible and can it take account of future transport and population changes?
- Are there other commercial opportunities associated with the development?

## BOX 4



# Design & Construction

## Design

- Safety engineering would be paramount and design would utilise modern fire resistant or retardant materials
- A balance of construction above and below ground would allow economies in design and construction as well as providing variety of environment in the interchange
- Design of any large open building requires careful co-ordination of structure and services. This is particularly important when that building is underground.
- High quality design and construction would be apparent in the finished structure and would give confidence to the users and play a large part in the success of a scheme
- Standardisation of building components would allow economies of scale and simplify future maintenance.

## Security

- Planning would create a manageable secure facility with the incorporation of surveillance systems to optimise security
- Secure storage and handling areas in freight terminals and baggage areas would be an intrinsic part of the design.

## Emergency Arrangements

- Planning of appropriate emergency control facilities within the interchange, allowing access facilities for vehicles, plant & personnel
- The design would allow emergency exercises which neither disrupt operational activities nor cause public alarm

BOX 5

## THE GOVERNMENT PERSPECTIVE

The Government White Paper (A New Deal for Transport 1998) has set clear guidelines for identifying the public benefits of transport investments by setting out its objectives.

These are:

- to help economic development across all parts of the country,
- more efficient use of scarce resources, including road and rail networks,
- to enhance the vitality of town and city centres,
- to meet the needs of rural areas,
- to reduce social exclusion and take account of the accessibility needs of all sectors of society, including the disabled,
- to ensure a high standard of safety across all forms of transport with improved personal security, and
- to make everyone more aware of the problems and solutions.



It has also provided a five-point framework for measuring the desirability from a policy perspective of any proposed transport scheme:

- **Environmental impact** - protecting the built and natural environment
- **Safety** - to improve safety of all road users
- **Economy** - supporting sustainable economic activity in appropriate locations and getting good value for money
- **Accessibility** - improving access to everyday facilities for those without a car and reducing economic severance
- **Integration** - ensuring that all decisions are taken in the context of the integrated transport policy



The Government has introduced a set of policies devoted to freight, and these include provision for financial assistance to transfer freight from road to rail.

The Government has also introduced new guidance on appraising multi-modal transport schemes. Within this guidance, traffic-modelling methodology works by calculating:

- costs and benefits to the passenger,
- the economic viability from the operators' viewpoint, then
- the benefit to the Government (in terms of reduced vehicle mileage and accidents).

In theory some interchanges could score very well in these calculations, as they take cars off the road and put passengers into more efficient public transport, such as buses. However, in practice there are a number of other factors to be taken into account, such as the capacity of the transport network and the links to it.

The new methodology recognises and is capable of assessing the much wider issues to be considered. As one component of a multi-modal scheme, inter-modal interchanges should score well on many of these issues and underground space could score particularly well in some areas.

Box 6 shows the criteria used in the government publication: 'Guidance for the Methodology for Multi-Modal Studies' (Department of the Environment, Transport and the Regions). Underground interchanges would score well in the areas of:

- noise reduction
- protection of landscape, townscape and heritage
- improving journey ambience (by relieving the stress of driving and because the standards adopted to make these interchanges attractive would make the experience of using them pleasant)
- security
- improving transport interchange
- integration with land use policy, and
- integration with other Government policies



# Government's Objectives

Government's Objectives for Assessing Multi-modal Schemes

	<i>Objective</i>	<i>Sub-Objective</i>
Environment	to protect the built and natural environment	<ul style="list-style-type: none"> <li>Reduce noise</li> <li>Improve local air quality</li> <li>Reduce greenhouse gases</li> <li>Protect landscape</li> <li>Protect townscape</li> <li>Protect heritage</li> <li>Support biodiversity</li> <li>Protect water environment</li> <li>Encourage physical fitness</li> <li>Improve journey ambience</li> </ul>
Safety	to improve safety	<ul style="list-style-type: none"> <li>Reduce accidents</li> <li>Improve security</li> </ul>
Economy	to support sustainable economic activity and get good value for money	<ul style="list-style-type: none"> <li>Improve transport efficiency</li> <li>Improve reliability</li> <li>Provide wider benefits</li> </ul>
Accessibility	to improve access for those without a car and reduce severance	<ul style="list-style-type: none"> <li>Improve access to transport system</li> <li>Increase option values</li> <li>Reduce severance</li> </ul>
Integration	to ensure that decisions are taken in the context of Government integrated transport policy	<ul style="list-style-type: none"> <li>Improve transport interchange</li> <li>Integrate with land use policy</li> <li>Integrate with other Government policies</li> </ul>

## BOX 6

## SUMMARY

Building underground multi-modal transport interchange facilities should be actively considered where:

- there would be a connection to existing underground transport,
- environmental considerations or existing buildings rule out surface construction, or
- surface space is commercially valuable.

Construction of the facility, either wholly or partly underground may offer some substantial advantages when evaluated against Government objectives. This is particularly the case in environmentally sensitive areas. Such benefits should be weighed against the increased costs of construction - which may be mitigated by prudent site selection and design.

Before you can think of planning an interchange, you need to be clear that:

- There is enough room in the public transport system to carry the extra passengers
- You can connect the interchange to the transport network at reasonable cost
- The interchange will actually attract passengers
- That building the interchange will help to reduce congestion and not increase it.

The bulk of public transport infrastructure is currently subsidised - either directly or indirectly. It is therefore likely that the financial viability of any such inter-modal interchange (whether above or below ground) would depend on the availability of future subsidy. However, by way of GOMMS (see Box 6), the Government now has in place clear measures for evaluating schemes and for speeding the development of those that it considers worthwhile.



## RESPONSES

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Responses to this Consultation Document should be made by 27 November 2000:

By post to:

Mr R Ford  
Highways Agency  
Room 3/54B  
St Christopher House  
Southwark Street  
London SE1 0TE

By email to:

[Underground\\_space@halliburton.com](mailto:Underground_space@halliburton.com)

Further copies of this document can be obtained from the Highways Agency at the above address. Additional details on the study can be found in the main report:

'Integrated Transport - The Development of Underground Space', Highways Agency, 2000 (provisional title, document in preparation)



# Examples

of



Bradford Travel Interchange

Bradford Travel Interchange is a multi-modal interchange linking bus and mainline rail modes located close to the City centre. The interchange has good rail links, though many involve changing at Leeds. An extensive coach service connects most parts of the country to Bradford Travel Interchange and to Leeds. There are regular bus services from the Interchange, but the local train service operates from Forster Square Station (a 15-minute walk away, with luggage), as does one direct London connection each day.



Bristol Parkway Railway Station

The station was purpose built to provide a park & ride site with a high-speed link to London. It connects with the Avon Ring Road and thus to the national motorway network. Facilities on site include toilets, baby changing facilities, dedicated first class parking and other parking, cycle racks, car hire, disabled access and toilets. Local buses are integrated with the station. The station buildings are currently undergoing refurbishment.



Europa Buscentre, Belfast

The Europa Buscentre provides a closely linked fully covered bus and rail interchange which is easily accessible without excessive use of steps. Design features include an integrated bus and rail facility, low level counters at booking offices, low level public telephones, textphone facilities, tactile flooring (for the visually impaired), high contrast signage, an induction loop, parents' room and toilets for disabled customers. The entrance to the bus station is through a retail mall containing convenience stores.



Gare du Nord, Paris

This is a huge interchange (five levels and 450,000 passengers a day). From an operational point of view the interchange works well - this is partly due to familiarity by regular passengers but also because of good management by SNCF/RATP. The number and range of passenger facilities such as cafes, kiosks, tourist offices is good. There are numerous information/direction signs but these are sometimes lost amongst other visual clutter

# Interchanges

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such as advertisements. The high numbers of passengers, together with good lighting levels gives the upper levels a secure feeling. The bus station is of poor quality compared to the main rail station area. A second main area of concern relates to physical accessibility issues: absence of obvious lifts and lack of dropped kerbs or ramps. Walk distances between Metro and main rail lines are long and difficult.



Duivendrecht Station, The Netherlands

This interchange sits at the junction between the rail line between Schiphol and Weesp and the Amsterdam-Utrecht line. The station also accommodates two metro lines and a link line for freight traffic. A few bus routes connect the station with the surroundings and Amsterdam. The users' sense of orientation is extremely important. Water has been a significant design element. Water features define area boundaries and provide a restful context. In many instances they obviate the need for fencing. The station itself is built of

white steel, bright by day and night. Roofs, canopies, glazing bars, handrails, lampposts and structural supports are all predominantly white. This also serves to emphasise the few external colour accents more strongly. Inside, the emphasis is on transparency and maximum visibility, across the concourse and platforms, and from level to level. Ticket office, shops and restaurant are situated at first floor level and staircases, elevators and lifts are clearly visible. Most interchanges take place between train and train (the two levels), because the station is mainly designed as an interchange between the two rail lines. Duivendrecht station is very modern and secure. However, people who change trains at the station for the first time (especially from/to Schiphol) do not always expect that they have to change to another level. Access and egress modes are integrated with the interchange (bicycle racks close to the platform, compact bus station, an open forecourt for pedestrians and car parking under the forecourt)