Review of telematics relevant to public transport

Prepared for Department of the Environment, Transport and the Regions

I J Wilkinson, K E Perrett, M W Pickett, M Wedlock and G Daugherty
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## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Executive Summary</td>
<td>1</td>
</tr>
<tr>
<td>2 Introduction</td>
<td>5</td>
</tr>
<tr>
<td>2.1 Study context and rationale</td>
<td>5</td>
</tr>
<tr>
<td>2.2 Review process and results</td>
<td>5</td>
</tr>
<tr>
<td>Part I: The potential for telematics to contribute to the development</td>
<td>9</td>
</tr>
<tr>
<td>and integration of public transport systems</td>
<td></td>
</tr>
<tr>
<td>3 The market size and growth trends for public transport</td>
<td>11</td>
</tr>
<tr>
<td>4 Policy objectives for public transport</td>
<td>12</td>
</tr>
<tr>
<td>4.1 Improving public transport</td>
<td>12</td>
</tr>
<tr>
<td>4.2 Limiting the growth of private car use</td>
<td>13</td>
</tr>
<tr>
<td>5 Scope</td>
<td>13</td>
</tr>
<tr>
<td>6 Examples of public transport telematics</td>
<td>13</td>
</tr>
<tr>
<td>6.1 Telematics applications for public transport</td>
<td>13</td>
</tr>
<tr>
<td>6.2 Information systems for trip planning</td>
<td>14</td>
</tr>
<tr>
<td>6.3 Portable information systems</td>
<td>18</td>
</tr>
<tr>
<td>6.4 Operational management</td>
<td>18</td>
</tr>
<tr>
<td>6.5 Bus priority systems and real-time passenger information</td>
<td>19</td>
</tr>
<tr>
<td>6.6 Multi-modal ticketing and integrated payment</td>
<td>20</td>
</tr>
<tr>
<td>7 Barriers to realising the potential of telematics in public transport</td>
<td>20</td>
</tr>
<tr>
<td>7.1 Need for evidence of financial returns from telematics applications</td>
<td>20</td>
</tr>
<tr>
<td>7.2 Protection of markets</td>
<td>21</td>
</tr>
<tr>
<td>7.3 Lack of investment</td>
<td>21</td>
</tr>
<tr>
<td>7.4 Focus on cost minimisation</td>
<td>21</td>
</tr>
<tr>
<td>7.5 Bus service instability</td>
<td>21</td>
</tr>
<tr>
<td>7.6 Ticketing complexity</td>
<td>22</td>
</tr>
<tr>
<td>7.7 Different stakeholder objectives</td>
<td>22</td>
</tr>
<tr>
<td>7.8 Competition from the car</td>
<td>22</td>
</tr>
<tr>
<td>7.9 Lack of integrated planning</td>
<td>22</td>
</tr>
<tr>
<td>7.10 Lack of standards</td>
<td>22</td>
</tr>
<tr>
<td>7.11 Need for further technological development</td>
<td>22</td>
</tr>
</tbody>
</table>
Part II: User needs for travel information for journeys by public transport

8 Travel information for public transport users

8.1 Aims

8.2 Scope

9 User needs for public transport travel information

9.1 Basic requirements and definitions

9.2 User needs by type of information

9.3 User needs by location of information

9.4 User needs by user group

9.5 User needs by type of journey

9.6 User needs by mode

10 Current practice in the dissemination of public transport information

10.1 Overview

10.2 Information content

10.3 Distribution medium and location

11 Current practice in the sourcing of public transport information

11.1 Overview

11.2 Sourcing trip planning information

11.3 Sourcing real-time in-trip information

12 Barriers to sourcing and dissemination of public transport information

12.1 Perceived importance of information provision

12.2 Lack of co-ordination of information in the bus industry

12.3 Lack of access to comprehensive information

12.4 Lack of consistency in presentation

12.5 Complexity of multi-modal network

12.6 Need for further technological development

12.7 Inequitable distribution of benefits from investment

12.8 Justifying investment in electronic information dissemination

12.9 Rate of change in information

12.10 User acceptability of electronic media

12.11 Disenfranchising those unable or unwilling to use electronic media
Part III: Synthesis and conclusions   41

13 Synthesis   43
   13.1 Underlying issues   43
   13.2 Solutions and recommendations: general policy framework   46
   13.3 Solutions and recommendations: specific areas of development   47

14 Acknowledgements   53

15 Bibliography   53

Appendix A: Summary of abbreviations   61

Appendix B: Examples of non-internet based information systems   62

Appendix C: Examples of internet based information systems   67

Appendix D: Examples of portable information systems   69

Appendix E: Examples of bus priority and passenger information systems   70

Appendix F: Examples of multi-modal ticketing and integrated payment   81

Abstract   83

Related publications   83
1 Executive Summary

The Government aims to tackle the forecast growth in road traffic by encouraging a modal shift to public transport while providing access to public transport for disadvantaged sectors of society and supporting a strong economy. To support the preparation of a White Paper designed to contribute to the delivery of this aim, the Department of the Environment, Transport and the Regions commissioned a study:

- to consider the extent to which emerging public transport telematics\(^1\) applications and technologies are being used;
- to consider the potential for improving public transport services, encouraging integration and stimulating modal shift which such technology provides, drawing on the results of evaluations of the impacts of this technology;
- to consider the extent to which the current performance of telematics systems is limited by the policy and market environment in UK public transport today;
- to make recommendations to facilitate the further development and effective implementation of technology for improving public transport services, encouraging integration and stimulating modal shift to public transport in the UK.

In Part I of the report the market for public transport services is reviewed as a prelude to the discussion of policy objectives for the integration of public transport and delivering modal shift. The growing dominance of the car as the main mode of travel in the UK is seen to reflect wider social, political and economic trends. It is recognised that delivering modal shift to public transport through improvements in services and information provision will be a difficult task while the car remains as convenient a mode of transport as it is today.

Telematics technology is seen to be just one tool available to help deliver improvements in public transport services, but it cannot deliver its full potential in isolation from other measures.

The report goes on to consider the potential role of public transport telematics in delivering improvements in service and information provision, looking in particular at the following applications:

- information systems for trip planning;
- portable information systems;
- operational management aids;
- bus priority systems and real-time passenger information;
- multi-modal ticketing and integrated payment.

A wide selection of technology trials based in the UK and in Europe have been reviewed. This is not intended to be a comprehensive listing of all ongoing activities in this area. Instead it aims to consider sufficient examples to be able to draw general conclusions about technological progress, the potential for improving public transport services and barriers to successful deployment.

These telematics applications offer the potential to make significant improvements to the quality of public transport services; however, some barriers to successful deployment were identified.

Part II of the report looks more specifically at the provision of information to meet user needs. The review considers the information needs of passengers in the context of types of information, location, user groups, types of journey and mode of transport. While meeting user needs is recognised to be of great importance in making public transport more attractive and accessible to users, it is concluded that user needs are extremely variable and diverse. In the context of the integration of public transport and multi-modal trip planning it is noted that there are significant differences in user need associated with mode. Any systems for providing information will therefore need to be sufficiently flexible to identify and respond to users needs appropriately.

The report moves on to consider current practice in the sourcing and dissemination of information to users. At present dissemination processes are mainly paper based, but this leads to problems which include presentation, distribution and accuracy. These may be addressed via electronic systems which are becoming increasingly popular, especially making information available via internet web pages. However, the sourcing of information to ensure accuracy and comprehensiveness is seen to be a key problem area, particularly in the bus industry.

Part III of the report presents a synthesis of the earlier sections and considers how the issues raised might be addressed effectively. The bus industry will need to play a major role in delivering public transport integration and modal shift. Yet the most significant constraint on realising the benefits of transport telematics and improving information provision for users is the current environment of cost-conscious competition and weak regulation in the bus industry. For this reason the solutions and recommendations focus extensively on measures affecting the bus industry as the first step towards delivering the Government’s objectives for public transport and facilitating the implementation of telematics applications.

Summary of recommendations

General policy framework

1 Public transport in the PTE areas should be supported through policies to improve access to services, improve passenger facilities, enable interchange between modes, provide information to passengers and encourage co-ordinated ticketing. Passenger Transport Executives are well placed to propose and implement such initiatives. They could be supported in this task by making available guidance on good (and bad) practice.

2 Policies should be pursued to balance the benefits of mobility provided by the car with the impact of traffic on the quality of life in urban areas. Policies to discourage the use of the car in congested urban areas

\(^1\)Transport telematics is the application of information and communications technology to transport problems.
should be pursued, while providing public transport with access to city centres. Well designed Park and Ride schemes should be encouraged where they can offer effective choices to use of the car.

3 Consideration should be given to mechanisms for encouraging investment in vehicles, passenger facilities and infrastructure, including an assessment to ensure that such investments would represent good value for money. Examples of mechanisms which could be explored further might include the introduction of financial incentives for the purchase of new vehicles (eg. grants or tax breaks), or by adding extra importance to measures proposed by Local Authorities, for example in TPP submissions, which will benefit public transport specifically (e.g. bus priority measures or enhancements to bus stops).

4 Government should declare to users and the industry its commitment to working to ensure the delivery of quality services and information to meet the needs of users. This may be achieved by publicising clearly the package of measures it is taking to this end, which might include the implementation of recommendations identified in this report.

5 The Government may wish to review, in the context of the following specific recommendations relating to the deployment of public transport telematics and the improvement of public transport information, the need to amend the current regulatory framework to improve the effective operation of the bus industry in the UK from the perspective of the user.

Improving static information about bus services

6 Government should encourage the establishment of a forum which aims to raise commitment to meeting the needs of users for public transport information across the whole industry. This idea is further elaborated below. This forum should include representatives of all the key stakeholders. The Government should make clear its desire to work through such a self-regulating, voluntary forum while making clear its intent to pursue regulation and possibly even legislation to ensure its objectives are met should the forum not deliver the required level of commitment and change.

7 Bus operators should be required as a condition of service registration, to provide original and updated service schedule information in a prescribed electronic format to the traffic commissioner and Local Authorities. The traffic commissioner and Local Authorities should be given powers to demand the timely delivery of such information from bus operators (i.e. to enforce any such regulation).

8 The traffic commissioners and/or Local Authorities should be encouraged to take the lead in coordinating (perhaps through operators, quality partnerships, contracting out or private sector initiatives) the collation and dissemination of bus service information for their geographical area. The information should be made available in an agreed electronic format to third parties, including publishers of paper-based timetables. They should also be encouraged to take the lead in ensuring that such information is made available via a freely-accessible, well-maintained internet web site. A working group comprising traffic commissioners, Local Authorities and Central Government, in consultation with user and operator representatives, should consider the detailed issues associated with ensuring the collation and dissemination of bus service information, including enforcement of the timely provision of accurate information, change control procedures and whether some of the flexibilities in changing service schedules should be reduced by regulation (e.g. discontinue the exemption from registration for service changes of up to 5 minutes). While proposals for the resolution of some of these issues may emerge from the Traffic Area Offices Working Group (which is reviewing efficiency in the Traffic Area Offices and looking at the practicalities of electronic registrations), ideally a group with a wider remit should be looking at the issue.

9 Consideration should be given to encouraging all Local Authorities and PTEs to take full responsibility for all bus stops in their geographical area, their condition, siting and naming. Services should be grouped at stops depending on destination, not operator. Bus operators should be required to provide consistent passenger information for all bus services at each stop and consideration given to the supply of power and communications to bus stops where real-time information may be provided. Despite the extent to which Local Authorities are already using GIS platforms for a wide range of tasks, defining bus stop location accurately is problematical for Local Authorities for cost reasons. Yet this is key to many aspects of delivering effective public transport information services. Consideration should be given to facilitating cost-effective access to Ordnance Survey map data for public transport applications.

Implementing telematics in the bus industry

10 It is recommended that a standard functional specification for bus location and priority systems should be developed. This should define clearly standard interfaces with other systems (as a minimum), to facilitate implementation of inter-operable bus priority and bus location systems over wide geographical areas as well as communication with other information systems.

11 The Government should consider further support for the effective evaluation of projects which aim to demonstrate or implement telematics technologies (specifically automatic vehicle location, fleet management, bus priority and passenger information systems applied over a wide area) to collect clear evidence of the costs and benefits from the perspective of the operators, users and Local Authorities (and PTEs). Where possible these projects should aim to build on best practice from existing systems. These and other evaluations should be disseminated (a) to the industry and (b) to Local Authorities and PTEs in guides to good practice, which also provide advice
(based on case studies) about available systems and how to make the most effective use of them. Demonstrating cost-effectiveness of investments may also require action to improve the market durability of telematics products, for example through the setting of standards.

12 Specific consideration should be given to encouraging Local Authorities and PTEs to monitor more closely the performance of bus operators in meeting agreed service levels to ensure the value for money of investment in local bus services. One (but not the only) means by which this might be achieved is through the establishment of a framework for user-focused performance standards (including information access and quality) and associated monitoring arrangements. In such circumstances consideration should be given to attaching special preference to TPP and other supplementary funding applications which aim to install bus priority and passenger information capabilities within the context of such a contractual framework.

13 It may be necessary to consider how construction and use regulations for buses may need to be modified to accommodate the installation of the appropriate in-vehicle equipment in new buses.

Access to real-time in-trip information

14 Consideration should be given to encouraging (possibly via funding jointly with the private sector, projects for research, development and/or demonstration) the development of a basic, inexpensive personal travel assistant which could be used on board bus and train services or at remote locations (e.g. at home). Such a device might be given to regular rail and bus passengers to provide added value services on public transport. Once established, enhanced devices with greater functionality, in all probability, would be marketed commercially. Such encouragement would be likely to bring such products to market more quickly and could also be used to raise public awareness of such solutions, increasing the rate and extent of market penetration.

Delivering integration

15 It is recommended that the Government should take an early lead in encouraging agreement across transport modes on common specifications, interfaces and standards. Specific areas of standardisation for consideration include, interfaces between information systems, interoperability between ticketing systems and the presentation of information to users.

16 Specific consideration should be given to the harmonisation across modes of guidelines for the presentation of time, service, fare, interchange and booking information for application to all transport modes and in all areas of the country. Such guidelines will need to cover both content and presentation of information. However, similar existing guidelines are rarely implemented effectively. To ensure that this information remains accessible to public transport users, particularly those who are physically disadvantaged, it will be important to work to secure the widespread and consistent implementation of these guidelines within the industry.

A national passenger transport information service

17 Consideration should be given to the development of a framework for a national passenger transport information service to facilitate trip planning by users of public transport systems.

18 Given the rate of growth in access to the internet, the large amount of information already available on web pages, and the ease and low cost of adding to and accessing this information, it is recommended that: an on-line link using internet protocols (though not necessarily public access internet systems) should be adopted as the vehicle for the national passenger transport information system; consideration be given to the development of a single (possibly geographically-based) user interface designed to elucidate quickly users’ requirements; internet protocol-based trip planning software (based on search engine software technology) should be used to access from well-maintained server-based sites the relevant information required by the user and for the effective presentation of that information to the user.

19 To facilitate the above approach it is recommended that the Government should: support the further development of trip planning software for searching for, retrieving and presenting information from decentralised, disaggregated sources; encourage or require (possibly as a service registration or licence requirement) relevant third parties (e.g. Local Authorities, PTEs, Railtrack, National Express, Ferry Operators, Airports, Taxi Companies) to collate and disseminate freely information about their services via an up-to-date server-based site (as well as other means) which provides free access to this information; encourage the development of other means of accessing this information for users with no direct access to the internet (e.g. via the travel trade, operators’ enquiry lines, a national telephone enquiry service, teletext, public access terminals in libraries and at passenger interchanges).
2 Introduction

2.1 Study context and rationale

2.1.1 Addressing the transport problem
In the consultation document ‘Developing an Integrated Transport Policy’ (DETR, 1997) the Government sets out to tackle the forecast growth in road traffic while providing access to transport for disadvantaged sectors of society, protecting the environment and supporting a strong economy.

Public transport systems have a potential role to play in delivering these aims because of their under-utilised capacity, inherent efficiencies and their existing role in helping to provide mobility for disadvantaged sectors of society.

To deliver a real impact on road traffic growth requires that public transport policy and technology development be focused on satisfying the needs of potential users drawn from the mainstream driving public. These potential users have the financial and physical means to exercise choice.

The Government will therefore need to work with all the relevant stakeholders to create the economic, social and political environment in which the mainstream driving public exercise that choice in favour of public transport for at least some types of journey. At the same time they must ensure that public transport systems are developed to meet the needs of the physically and financially disadvantaged.

2.1.2 The role of technology
Telematics technologies are one of a number of tools available to policy-makers for delivering policy objectives. But they are just that - a tool. To be successful their development and implementation must be seen as one element of a strategy which encompasses other, complementary measures and is designed to meet the necessary objectives. Having said that, telematics systems can be extremely powerful tools, with the potential to play a significant role in helping to deliver policy objectives.

The rationale of this study is

- to consider the extent to which emerging public transport telematics applications and technologies are being used;
- to consider the potential for improving public transport services, encouraging integration and stimulating modal shift which such technology provides, drawing on the results of evaluations of the impacts of this technology;
- to consider the extent to which the current performance of telematics systems is limited by the policy and market environment in UK public transport today;
- to make recommendations to facilitate the further development and effective implementation of technology for improving public transport services, encouraging integration and stimulating modal shift to public transport in the UK.

2.1.3 Meeting user needs through integration
One of the Government’s key objectives for public transport is the presentation to the user of the ‘seamless journey’. Given that public transport users have only a small role to play in ensuring their safe movement from one location to another, it should not be necessary for them to have to understand or even be aware of the complexities of the different transport systems on which they travel in order to fulfil their desire for mobility. All they need is access to information on which to make decisions. This concept is illustrated in Figure 1. The top diagram illustrates how the user is presented with a plethora of information from a wide range of sources related more to modes than to their trip-related needs. The lower diagram illustrates how the integration of information provided to users more effectively meets user requirements for a seamless journey.

2.2 Review process and results

2.2.1 Requirement
The Government aims to tackle the forecast growth in road traffic not least by encouraging a modal shift to public transport while providing access to public transport for disadvantaged sectors of society and supporting a strong economy. To support the preparation of a White Paper designed to deliver this aim, the Department of the Environment, Transport and the Regions commissioned a study to:

- identify the potential role of telematics2 in encouraging passenger travel by modes other than the car, with particular reference to all inland modes of public transport; and
- identify constraints and recommend how the Government and other bodies could facilitate the development and implementation of such technologies.

The study focuses on assessing the scope for new telematics technology to contribute to the development and integration of public transport services before going on to consider one specific area of interest - public transport travel information. This latter review is placed in the context of an assessment of user needs for information.

2.2.2 Review methodology
The Transport Research Laboratory (TRL) conducted a review of existing activities in the field of public transport telematics in the UK and surveyed the lessons learned from research evaluations of such systems undertaken in the context of UK and European research projects. This was achieved by reviewing published literature and through continuing contacts with key individuals in the industry, in the research field and in these projects.

Given the time available and the range of public and private sector initiatives in this area, the review could not begin to cover ALL on-going activities. The aim has been, therefore, to review sufficient of those activities to be able to learn the lessons of current experience and to use this as the foundation on which to frame recommendations for future developments.

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2Transport telematics is the application of information and communications technology to transport problems.
The preliminary conclusions of this review were validated against the views and opinions of a panel of key stakeholders in the public transport industry in the UK. The panel members were provided with a copy of the report and a ‘round table’ discussion of the key issues was held. The authors have aimed to reflect in this final document the views expressed by the panel members.

2.2.3 Report structure

The report is in three parts:

**Part I The potential for telematics to contribute to the development and integration of public transport systems**

This section reviews, in the context of the current market and policy objectives, examples of public transport telematics applications and technologies in practice and the barriers to successful deployment of telematics.

**Part II User needs for travel information for journeys by public transport**

This section explores further the provision of information about public transport services. An analysis of user needs for information is presented followed by a review of current arrangements for the dissemination and sourcing of such information.

**Part III Synthesis and conclusions**

This section looks at the issues identified in the first two parts of the report and considers possible solutions which are developed into a series of recommendations. These aim to identify initiatives for consideration by Central Government designed to facilitate the improvement of public transport services and information provision through the application of telematics technology.

The report concludes with a series of appendices containing abbreviations used in the report, and examples of some of the applications discussed in the Section 6.
Figure 1 The concept of integrated information provision
Part I: The potential for telematics to contribute to the development and integration of public transport systems
3 The market size and growth trends for public transport

Over the last 10 years there has been an explosion in demand for personal travel. This demand has been met almost entirely by the car (see Table 1). Public transport has simultaneously lost market share and failed to capitalise on a significant market opportunity.

In 1996, public transport accounted for 12 per cent of the total passenger kilometres travelled in Great Britain. Road based public transport (bus and coach) comprises 6 per cent of the total, rail 5 per cent and air travel 1 per cent. Private passenger transport accounts for the vast majority (88 per cent) of the total distance travelled. This is shown in Figure 2.

Table 1 Passenger transport volumes in billion passenger kilometres travelled

<table>
<thead>
<tr>
<th>Passenger transport</th>
<th>1986</th>
<th>1996</th>
<th>% change within mode</th>
<th>% of change</th>
<th>% of total change</th>
</tr>
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<tr>
<td></td>
<td>billion passenger kilometres</td>
<td>billion passenger kilometres</td>
<td>Absolute change</td>
<td>within total passenger kilometres</td>
<td>within total passenger kilometres</td>
</tr>
<tr>
<td>Bus &amp; Coach</td>
<td>47</td>
<td>44</td>
<td>-3</td>
<td>-6%</td>
<td>-2%</td>
</tr>
<tr>
<td>Rail</td>
<td>37</td>
<td>38</td>
<td>+1</td>
<td>+3%</td>
<td>+1%</td>
</tr>
<tr>
<td>Air (domestic only)</td>
<td>4</td>
<td>6</td>
<td>+2</td>
<td>+50%</td>
<td>+1%</td>
</tr>
<tr>
<td>Motor &amp; pedal cycle</td>
<td>13</td>
<td>8</td>
<td>-5</td>
<td>-38%</td>
<td>-3%</td>
</tr>
<tr>
<td>Car, van &amp; taxi</td>
<td>465</td>
<td>620</td>
<td>+155</td>
<td>+33%</td>
<td>+103%</td>
</tr>
<tr>
<td>All modes</td>
<td>566</td>
<td>717</td>
<td>+151</td>
<td>+27%</td>
<td></td>
</tr>
</tbody>
</table>


Figure 2 Share of passenger km by mode in 1996 (TSGB, 1997)

So, not only is the market for travel by car dominant over public transport, it is increasing in market share. Over the ten year period from 1984-1994, car ownership in the UK increased by 26 per cent, and distance travelled by car increased by 42%. People are owning more vehicles and using them to drive further.

Over the same period the bus industry has undergone fundamental change following deregulation in 1986 (except in London). The vehicle fleet has increased by 11 per cent since 1986, with a major shift to smaller vehicles and a decline of about a fifth in double deck buses. Major reductions have been achieved in operational costs. Bus revenue over this period has remained almost static in real terms, though the total number of bus journeys has declined by 22 per cent. In London, there has been a 5 per cent increase in local bus journeys over the same period.

It is an established fact that it is very difficult to get motorists to forsake the private car. Once a decision has been made to purchase a car and the fixed costs (e.g. depreciation, tax, insurance) are paid, motorists tend to use the car for all trips. Of course, not all members of a car-owning family can have access to the car. They will continue to use public transport, but may reduce these trips, preferring to wait until the car is available, e.g. for shopping. Figure 3 shows how car journeys increase with age (until retirement) while stage bus trips decline over this period.

There is a strong trend towards an increasing proportion of people having licences to drive. For example, in 1975, 37 per cent of women aged 40-49 held a driving license. By 1994/96, this had doubled to 74 per cent. Inevitably, this will mean that more people will have access to a car. A further one per cent increase in private car use would mean a 17 per cent reduction in bus use if all the trips transfer from bus.

There are several distinct markets for public transport. In the major urban areas, comprehensive services are offered with regular, high frequency services which run all day, including early morning and late night services. Features such as passenger information and ticketing are co-ordinated and inter-modal travel is supported within the constraints of the privatised bus and rail industry. Passenger receipts from bus services in the metropolitan areas and London together account for half of the total local bus revenue. Taken together with increased congestion and problems associated with parking, there are significant opportunities for encouraging motorists to transfer to public transport. The availability of parking at the destination is known to be a strong determinant in modal choice. If the traveller feels that parking will be difficult and/or expensive, then other choices may become more attractive. Congestion, particularly in urban areas, will make private cars trips less reliable and more frustrating. If steps are taken to ensure that public transport does not suffer the same level of delay, then some drivers may be persuaded to transfer.

In more rural areas bus services are usually of much lower frequency and operate for only part of the full day. Inter-modal trips are more difficult and ticketing is less likely to be co-ordinated. Destinations are more limited as the services tend to be run on a route by route basis, rather than as a network. Without offering the choice of destination, time of travel and service frequency available in urban areas, rural bus services are at most risk from competition with the private car.

The market for rail trips is different again and there are more opportunities for encouraging transfers from car to train. High levels of comfort and reliability and savings in time can be achieved, particularly on longer trips. If access to the station by car is easy and the passenger can reach the final destination from the railway station, then this option becomes even more attractive. Total passenger kilometres increased by 7 per cent between 1986 and 1996. However, fundamental changes in the structure of the rail industry have recently been made and these may complicate the process of encouraging transfer of mode to rail. The privatisation of the rail industry and the formation of separate operating companies means that ticketing schemes and the provision of co-ordinated information are issues as indeed
they were with bus deregulation.

While the passenger kilometres travelled on London Underground stayed constant over the ten years from 1986 to 1996, the revenue increased by 38 per cent. So, parts of the market for public transport can be seen to be growing, while other parts are declining. The greatest opportunities are those where public transport can compete with the private car in offering a comfortable, reliable, door-to-door service.

88% of all travel in the UK (in terms of passenger km) is undertaken by car, van or taxi. Of these journeys 58% are less than five miles long with a further 21% from 5-10 miles long. Of all journeys made where car or van is the main mode 18% of mileage relates to commuting and 12% to shopping. If some of these journeys can be diverted to public transport the projected rate of growth in traffic will be reduced producing, amongst other things, an improved operational efficiency of the existing road network and the reduction in vehicle emissions. In general many of the private car journeys that could be influenced are regular journeys between home and work or nearby shopping centres.

4 Policy objectives for public transport

For the Government’s overall aims for the UK’s inland transport system to be realised it is necessary to achieve the core objective of shifting some trips from car to public transport - to deliver modal shift. There are two elements to any strategy. The first is to improve the quality of public transport services through integration. The second is to manage and even constrain the growth and use of private cars.

This review is concerned primarily with the former. It does not attempt to consider telematics applications which could facilitate the management of demand for transportation by car.

4.1 Improving public transport

To create the environment in which users will choose to travel by public transport when they could alternatively travel by car will mean:

- working from the perspective of users who are currently car drivers and passengers, understanding their attitudes and motivations;
- considering the trip by car as the benchmark against which to evaluate service improvements.

This approach has a number of implications. At the basic level, public transport systems will need to be developed to offer an improved quality of service, preferably one comparable to that provided by cars. From the user’s point of view, the key factors will be:

- quality of service
  - ease of planning (including access to information, information accuracy, comprehensibility, etc., system simplicity & comprehensibility)
  - ease of use (including door-to-door convenience, payment methods, reservations systems)
  - the travelling environment (cleanliness, noise, other people, availability of in-trip information, availability and quality of waiting and toilet facilities)
- time
  - end to end duration of journey
  - reliability of arrival time relative to expected or published arrival time
- cost
  - perceived value for money
  - total cost relative to the marginal cost of motoring (assuming traveller already owns car)
  - hidden or unforeseen costs
- non-travel related factors
  - display of social status, fashion or style
  - perceived freedom / versatility
  - crime / perception of crime
  - sustainability and environmental issues
Telematics applications which deliver improvements in these areas directly, or via improved integration within or between public transport modes, will in principle contribute towards delivering modal shift. In practice, however, the extent to which modal shift is realised will be determined by the degree to which the improved level of service matches the level of service attainable by car.

In the context of achieving modal shift, however, it will be just as important to ensure that the existing public transport customer base is retained, so that any improvements in service quality and steps to improve access for all sectors of society will be a valuable contribution to the Government’s objectives.

### 4.2 Limiting the growth of private car use

A 1 per cent decrease in car use would mean an increase of 17 per cent in bus use, if all the trips transferred to bus. If the trend towards increasing car use can be reversed, the market for public transport trips could increase substantially.

Policies which improve public transport will help towards attracting additional passengers. However, it is recognised that these policies may need to be supported by other policies which limit the use of the private car, possibly at certain times of the day, or within congested areas.

Policies which place limitations on the use of the private car are extremely difficult to introduce. Public acceptance of the overall benefit is, of course, essential. However, cities throughout Europe are steadily moving towards such policies. It will be important to achieve a balance between the dis-benefits which may arise through the loss of freedom to use the car for all trips and the benefits gained through faster, more reliable trips. Within this study, no assumptions have been made about any policies which might be introduced to limit car use. The focus has therefore been on improving the public transport services through the application of telematics.

### 5 Scope

This review is concerned with:

- passenger trips made entirely within the United Kingdom;
- all public transport modes;
- single and multi-stage journeys.

To place the following discussions of different modes in perspective, Table 2 enumerates their relative roles in the overall public transport market in the UK.

Comparable statistical information was not available for ferry services, although at the same time ferry services accounted for 1m ‘coastwise’ vehicle trips (i.e. non-overseas routes).

### 6 Examples of public transport telematics

This section presents an overview of new developments in telematics under a series of application-based headings. It is not intended to be a completely comprehensive listing of all activities in these areas. Instead it aims to provide a flavour of the main areas of development in sufficient detail to be able to draw conclusions about the state of the existing technologies, their potential benefits and constraints on their effective implementation. Examples of some of these developments are listed in a series of appendices to the report.

#### 6.1 Telematics applications for public transport

Telematics can be used at various stages in the process of making trips. Public transport passengers have particular needs in planning trips by public transport, particularly those which require use of several modes. Such systems are normally used before the trip, but there may be scope for public terminals offering trip planning opportunities. Once users have decided to make a trip, they may be provided with real-time information for the specific mode being used, such as bus arrival times. Technology is developing to provide such information direct to the user by means of a small communications device. Operators are using telematics to improve the management of their services. Knowledge of the location of buses and trains will enable operators to make decisions to improve the service delivered to the customers. Once vehicles are fitted with some form of location equipment, this can be used in two ways. Firstly it can be used to provide priority through the network to improve the service provided by public transport. Secondly the information can be provided to travellers to keep them informed about arrival times and any delays. Telematics may also be used to support new ticketing schemes via a single means of payment for a variety of travel requirements on different modes. The major developments in the UK and in Europe involving public transport telematics have been categorised as follows:

- Information systems for trip planning;
- Portable information terminals;
- Operational management;
- Bus priority systems and real-time passenger information;
- Multi-modal ticketing and integrated payment.

Each area of application is now considered in detail. In the appendices to this report, a number of examples of the telematics applications are presented in terms of description, coverage, costs and impacts, barriers to implementation, plans and, where available, other information. A summary of the main issues is provided at the end of each section.

### Table 2 Analysis of public transportation by mode in billion passenger kilometres travelled in 1996

<table>
<thead>
<tr>
<th>Public transport mode</th>
<th>bn passenger km</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface rail</td>
<td>32.0</td>
<td>34</td>
</tr>
<tr>
<td>Local bus</td>
<td>28.1</td>
<td>30</td>
</tr>
<tr>
<td>Non-local bus &amp; coach</td>
<td>15.9</td>
<td>17</td>
</tr>
<tr>
<td>Underground, metro &amp; light rail</td>
<td>6.6</td>
<td>7</td>
</tr>
<tr>
<td>Domestic air</td>
<td>6.3</td>
<td>6</td>
</tr>
<tr>
<td>Taxi**</td>
<td>6.3</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>95.2</td>
<td>100</td>
</tr>
</tbody>
</table>

*92% of which accounted for by London Underground Limited
**Calculated pro-rata from 1984 figures when taxis accounted for 1/7 of bus/coach passenger km
6.2 Information systems for trip planning

6.2.1 Non-internet based information systems

There already exist a wide range of information systems for supporting trip planning activities. The extent to which these are accessible in electronic form, particularly via the internet, is increasing rapidly. However, they remain at this time largely fragmented and isolated sources of information from the perspective of the user. Two approaches have emerged for attempting to present this information to the user as a single, easy to access source: centralisation and distributed processing. Figure 4 illustrates the difference between these general approaches.

The centralised approach seeks to draw the information together into one major source document or database. A number of failed attempts over the past decade or more for centralising public transport information have highlighted the weaknesses of a centralised approach for this application - the inability to keep pace with the rate of change in information leading to inaccuracy, and the tremendous volume of information leading to incompleteness. In the past, swayed by the capacity of IT to access and process increasingly vast quantities of data, too much attention was focused on comprehensiveness and too little on the cost of keeping the information up to date. While the technology may have been a match for the data processing and presentation tasks, its outputs can only reflect its inputs, which are not computerised. They are drawn from the entire public transport system, reflecting the underlying financial pressures, organisational structures, management systems, staff capabilities, priorities and attitudes at every level and in every industry.

Figure 4 A comparison of the management of change information in centralised v distributed approaches to information systems architecture
which contributes information to the centralised system. This is an inherent problem in centralised systems which is much easier to address in diffuse systems (where each of the components is smaller, easier to manage and where it is more straightforward to identify and correct underlying weaknesses in input information). It is not unusual for the management of change information to be a weak link in such a centralised system.

The centralised approaches being developed today have learned some of the lessons of the past and have recognised the need to ensure accuracy, which they achieve at the expense of completeness. For bus service information this is achieved, for example, by focusing on collecting and presenting data mainly, though not exclusively, from the largest companies. The Great Britain Passenger Rail Timetable is a notable exception in so far as it is produced as a regulatory requirement in the rail industry and can therefore be both comprehensive and accurate.

The distributed approach to information collection has been used for many years. Before the advent of Information Technology the approach was very time-consuming and required considerable expertise and knowledge of transport systems. It forms the basis of travel agencies and, to some extent, transport enquiry lines. The capabilities of these service providers have been increased substantially by the introduction of IT, providing swifter access to a broader range of more detailed information. Now the technology is moving a step further towards providing an even larger pool of inexperienced and un-knowledgeable users with trip planning capabilities via expert systems operating on distributed systems. This has been made a realistic possibility for large numbers of users specifically by the development of the internet, internet protocols, search engines and other associated software developments.

The distributed approach uses software to identify relevant sources, access and interrogate those sources and collate and provide the information seamlessly to users to meet their needs. Such systems have the advantage that the supply and maintenance of information is dispersed across a large number of suppliers (and therefore so is the cost), keeping the information management task manageable and thereby ensuring accuracy (providing the information supplier is committed to keeping their part of the system up to date). The system can also be as comprehensive as the coverage of the transport systems by these disparate sources, providing the processing capability of the trip planning software is up to the task.

There are a huge number of activities taking place in this area, some research-based, some implementation. A small number of projects are reviewed here primarily to provide a flavour of the ongoing research and evaluation in this area.

A key recent development has been the agreement of a data transfer protocol by a working party comprising the Association of Transport Co-ordinating Officers and the main suppliers of Journey Planning Systems in the UK (Pindar Routel, Station Master (Software Logic), Figurehead, Anite, WS Atkins, Logan, Community Technology). This protocol allows data from different journey planning systems to be transferred on an occasional basis to a different system, either within the same authority or between adjacent authorities.

Many information systems have been developed within the public transport industry as tools for staff providing customer enquiry services. These systems could be developed for wider use, but since the new users will be less familiar with the transport system / mode, it is likely to be necessary to significantly redevelop the user interface. It will also be necessary to develop more comprehensive sources of information, since most of these existing systems are mode-specific and sometimes company-specific.

Other freely-available electronic passenger information systems have been developed by Local Authorities, often in telematics research projects. These are usually sited at major transport locations such as bus stations and shopping centres. The key factor in judging the utility of such terminal/kiosk-type systems is how effective they are in meeting the needs of those who use them, particularly new users who may be a relatively small proportion of all travellers. With a greater demand for information, new users may also be more alert to the opportunities of such information sources and therefore more likely to experiment with them.

In considering the likely future deployment of such systems a key issue is their financial viability as stand-alone products or services. Valuing the benefits to justify investment in these systems can be problematic and depends on the perceived impacts on traveller behaviour and on who receives the benefits.

In the simplest valuation, some services generate revenue directly from premium line call charges (e.g. the Southern Vectis Train, Bus and Coach Hotline) or paper document sales. Another means of valuation is to estimate the (increase in) fare revenue associated with trips made as a consequence of using the information or trip planning service. It is particularly difficult to assign a value to this specific factor since trip-making behaviour is influenced by so many other factors. While the situation is clearer for other modes, for bus trips the issue may be which bus operator receives the increase in revenue. The industry may also value the increase in confidence of existing users which keeps them as customers rather than losing them to other modes. Outside London there are no regulatory requirements to redistribute fare revenue between operators, so that costs incurred by one operator to provide information may lead to revenue increases for another. In London there is a revenue pool with an agreed distribution to each operator. The apparent commercial success of ROUTES is therefore influenced by its ability to increase the overall revenue pool. Without co-operation between operators outside London such systems therefore face a substantial obstacle unless they are funded by the public sector.

Anecdotal evidence suggests that the cost of provision of a number of hotlines and enquiry services are covered by revenue increases, either through call charges or fare revenue. It is generally considered too early to judge whether current internet services will cover their costs. Being available for the cost of a local telephone call, internet access to information is entirely consistent with the objective of making the public transport information
available ‘free’ to the user. It is clear, however, that there are a number of internet and more conventional information services which operate at a loss. Some continue to be maintained, however, either because they are primarily advertising / marketing activities or because the providers consider this to be a growing market in which they need to establish a strong market position. It is also valuable to acknowledge that, because they are self-service systems, the cost of running internet-based information services does not vary with usage. They will, therefore, become much better value for money as more and more people have access to them.

In considering how to provide this information for trip planning purposes free to the user, it may be more realistic to encourage or require the numerous organisations working in the public transport arena to support numerous small, relatively inexpensive information sources (which are under local control and meet local needs) rather than face trying to find the significant funding required for maintaining a single source of information. This approach also capitalises on the investments already made in, as well as the local enthusiasm for, such information sources.

These information systems can be sub-divided into those that use the internet and those that do not. Those that do not are focused around other technologies, such as public information terminals and telephone enquiry lines. Some examples of non-internet based information systems are presented in Appendix B.

6.2.2 Internet based public transport information systems

The role of the internet as a mass information system is increasing rapidly with the increasing home ownership of PC systems (28% of homes had a PC in 1995 of which 5% were connected to the internet) and with the expansion of the digital network through cable operators providing a low cost telematic infrastructure. The pace of change in this area is such that these statistics change almost daily. Access is now certainly considerably higher than this 1995 level. For example, recent surveys of rail users have shown that 30% of customers claim to have at least casual internet access and the numbers are growing rapidly, especially via work access.

As a medium for disseminating information, the internet has the main benefit over printed timetables of providing access to information from anywhere in the country. This includes not only geographical areas that previously would not have had access to the printed information (e.g. bus timetables are normally only distributed locally), but also other locations that would not normally have held such data (e.g. offices, schools, colleges).

The presentation via the internet of electronic timetables has advantages for both the consumer and operators:

- timetables can instantly be updated without the lag time associated with the printing of timetables and posting them at bus stops, so improving the accuracy of information;
- personal timetables can be generated for specific enquiries without having to sift through large books of timetables;
- for operators the main advantage is cost saving, once the system has been set up, since people will be able to use the system and print out the relevant information they require, eliminating the need for large numbers of hard copies of timetables to be produced and reducing the number of personnel required to handle enquiries.

However, the use of the internet also has its disadvantages:

- delays when trying to access and download information;
- communications costs;
- limited access to socio-economic groups C, D and E which includes a significant proportion of bus customers.

If the current trend of increasing home ownership of PCs with internet access continues, then the demand for on-line information about public transport will encourage more operators or local authorities, to spend the initial investment to transfer to an internet accessible timetable/journey planner system. In most cases the system is already in place, as it is used by company employees to provide information through telephone enquiry lines, the systems just need to be integrated with other operator systems to provide a multimodal system accessible by the public via the internet.

Extent of internet usage today

At present 25 public transport authorities and operators in Britain provide internet-based information on public transport in their region. Of these only nine allow multimodal journey planning, and the Railtrack database forms an integral part of these journey planners (see Table 3). Some examples of internet based information systems are described in Appendix C.

In a recent survey of 99 Local Authorities 66% have or are soon to have a database for local public transport services. Of these 70% use the databases to provide information to operators of telephone enquiry services and 50% use the databases to provide information on the internet. At present only about 10% use their databases on the internet, although another 40% are expecting to do so shortly. This represents a significant level of activity at the local and regional level in the UK. Of the authorities which did not have a database 43% said that the main reason for not having one was insufficient budget and 23% said that they were unaware of the benefits which it would provide them (Slevin, 1997b).

There are two main problems facing a local authority in the setting up of databases of local bus services:

- The quality of information on a route is often limited, because times are only available for specified timing points and operators have the freedom to choose the number of timing points on a given route. Times for intermediate bus stops are hence unavailable and details on the route can be sparse;
- In the deregulated environment operators have the freedom to change or remove services on any day at will. For significant changes 6 weeks notice must be given to the traffic commissioners and the relevant local authority. However for adjustments for up to 5 minutes no notification is required.
Since the deregulation of the bus sector in the UK, there is often more than one operator on a given route, and services are often bunched around times and locations where loadings are viewed to be the highest. In these circumstances, operators have little interest in providing or adhering to timetables. When they do so, they may only provide frequency guides for services at bus stops and fail to advertise competitors services. If public transport users are to be able to plan trips it may be necessary to consider restricting the ability of operators to exercise such commercial freedoms and/or to empower a third party / impartial body to provide information suitable for trip planning purposes.

The problems for electronic rail timetables are less severe as the central database of timetables is still maintained by Railtrack after privatisation. This is because it was part of the central information system which is essential for the planning and running of day to day services on the tracks. This has enabled the setting up of an on-line Railtrack journey planner which gives the quickest route between two stations, but there is no information on fares. This system also has been added to include some local bus services to give a multimodal trip planner. The rail industry expects to have moved to a rolling 12-week schedule for such alterations by Summer 1998. The Railtrack planner includes details of some bus services that have replaced train services and also for ferry crossings originally operated by British Rail.

National Express has just introduced a new computerised ticketing system for its national coach operation which as well as being used by company employees at information desks, can be accessed via the internet to allow on-line journey planning in the UK and in Europe. The system allows start and finish destinations to be entered and preferred date and time of travel. It gives six choices of start time, if there are valid services, and once information about the type of journey/passenger has been entered, the relevant fare is given. Through the entering of details, payment can be made automatically via credit card and tickets are posted out and will arrive in 4 days for UK addresses.

The major UK airlines, British Airways, British Midlands and Air UK have internet sites which allow the browsing of schedules and on-line ticket reservations and payment by credit card, the tickets being sent out by post. The airports, too, have internet sites. The multi-modal journey planner for access to BAA Heathrow Airport now has about 1m users per week. This service is targeted specifically at the 56,000 airport staff and is complemented by a telephone travel enquiry line. The system also provides the facility for ordering tickets.

Table 3 Examples of Internet sites showing trip planning information and systems

<table>
<thead>
<tr>
<th>Operator/Authority</th>
<th>Web page address</th>
<th>Bus frequencies only</th>
<th>Bus/tram timetables</th>
<th>Single mode journey planner</th>
<th>Multi-modal journey planner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brighton &amp; Hove Bus Company</td>
<td><a href="http://www.buses.com">www.buses.com</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxford Bus Company</td>
<td><a href="http://www.oxfordbus.co.uk/cityline/index.htm">www.oxfordbus.co.uk/cityline/index.htm</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nottinghamshire County Council</td>
<td><a href="http://www.nottscc.gov.uk/utc/tpintro.htm">www.nottscc.gov.uk/utc/tpintro.htm</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Yorkshire PTE</td>
<td><a href="http://www.sypte.co.uk">www.sypte.co.uk</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fareham</td>
<td><a href="http://www.fareham.com">www.fareham.com</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Havant</td>
<td><a href="http://www.havant.gov.uk/usefulinfo/busstart.htm">www.havant.gov.uk/usefulinfo/busstart.htm</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lake District</td>
<td><a href="http://www.uk-north.com/transport/timetables.html">www.uk-north.com/transport/timetables.html</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saffron Walden</td>
<td><a href="http://www.webserve.co.uk/clients/saffire/travel.html">www.webserve.co.uk/clients/saffire/travel.html</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Highlands</td>
<td><a href="http://www.gael-net.co.uk/travel/index.html">www.gael-net.co.uk/travel/index.html</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isle of Skye</td>
<td><a href="http://www.gael-net.co.uk/skieways/bus.html#KPB">www.gael-net.co.uk/skieways/bus.html#KPB</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Midlands Travel</td>
<td><a href="http://www.travelwm.co.uk">www.travelwm.co.uk</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>London Underground</td>
<td><a href="http://www.londontransport.co.uk/">www.londontransport.co.uk/</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tyne &amp; Wear PTE (Metro)</td>
<td><a href="http://www.tag.co.uk/twpta/default.htm">www.tag.co.uk/twpta/default.htm</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Merseyside PTE (Metro)</td>
<td><a href="http://www.metro.jussieu.fr/">www.metro.jussieu.fr/</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GMPTE (Manchester Metrolink)</td>
<td><a href="http://www.gmpte.gov.uk">www.gmpte.gov.uk</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Railtrack</td>
<td><a href="http://www.railtrack.co.uk">www.railtrack.co.uk</a></td>
<td>✔</td>
<td>✔(limited)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>National Express</td>
<td><a href="http://www.nationalexpress.co.uk">www.nationalexpress.co.uk</a></td>
<td>✔</td>
<td>✔(limited)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North West Trains</td>
<td><a href="http://www.nwt.rail.co.uk">www.nwt.rail.co.uk</a></td>
<td>✔</td>
<td>✔(limited)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lancashire County</td>
<td><a href="http://www.lancashire.com">www.lancashire.com</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cumbria County</td>
<td><a href="http://www.wwwebguides.com/pubtrans/cumbria/info.htm">www.wwwebguides.com/pubtrans/cumbria/info.htm</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Yorkshire PTE</td>
<td><a href="http://www.ukbusu-net.net.uk/cgi/pexec?C=Metr&amp;x=0&amp;S=N&amp;">www.ukbusu-net.net.uk/cgi/pexec?C=Metr&amp;x=0&amp;S=N&amp;</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hertfordshire County</td>
<td><a href="http://www.ukbusu-net.net.uk/ibcounty.htm">www.ukbusu-net.net.uk/ibcounty.htm</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedfordshire County</td>
<td><a href="http://www.ukbusu-net.net.uk/ibcounty.htm">www.ukbusu-net.net.uk/ibcounty.htm</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buckinghamshire County</td>
<td><a href="http://www.pindar.co.uk">www.pindar.co.uk</a></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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18 ferry companies, operating out of UK ports, have internet sites giving details of crossing timetables and some companies like P&O and Sea France have the facilities for on-line bookings.

In Europe there are a number of schemes that provide information on public transport including journey planning and advance payment. These sites often use the same software as the company uses to book and issue tickets. In 1996 Munich became the first European city to provide on-line information about traffic and public transport as part of the Munich-Comfort scheme. European operators have recognised the importance of accurate customer information and have provided an information system on the internet, allowing journey planning within Germany and across Europe. There are sites giving timetable information on rail travel in 18 European countries as well as sites giving information on international high speed trains such as Eurostar and Thalys.

Good practice guidance

This is a guide for presenting public transport information on the internet. Public Transport information on the internet should be user friendly and easy to download, according to a report by Mari Anne Kalsson of Chalmers University in Sweden. Requirements for information on public transport via the internet can be found on the internet site. Currently there are few users of the World Wide Web who have text only browsers, or who use monochrome displays. With the advent of new palm top and mobile phone based web browsers, which are particularly relevant to people on the move, the demand for text-only and monochrome capabilities is expected to increase. This will be an important consideration in the designing and developing of travel information sites of this type (see http://www.tkgbg.se:280).

6.3 Portable information systems

As portable information sources go, paper is the standard against which others have to be measured. The key weaknesses of paper sources are the tendency to go out of date quite quickly and the difficulty in providing detailed information in a way that is easy for users to understand. Increasing moves towards the use of electronic media for storing and accessing public transport information have inevitably led to interest in developing systems for providing access to this information en route or at specific journey points (e.g. interchanges and destinations).

The review of on-going work in this area has identified a number of international trials and a few UK examples of the development of information kiosks and personal information devices. The evaluation of kiosks or terminals has highlighted a number of problems the main ones being the cost of the hardware and their accessibility to users. In considering the longer term future of such technology, the key issue is the extent to which users refer to these systems for information.

Accessibility to users is first and foremost an issue of exact location. This may explain some of the poor usage results obtained in live systems tests. Work in the USA on journey planners at airport terminals has shown that positioning such systems is absolutely critical to within a few feet of a particular point. Providing this position can be determined and the terminal can be sited in this location, provision and installation costs may cease to be an issue if advertisers can be found.

As well as being prone to vandalism, terminals also raise specific problems in meeting the needs of disabled users. For example:

- screen height, angle and lighting may need to be adjustable to meet the needs of people in wheelchairs;
- audio output and special screen technology would be needed to meet the needs of the blind; and
- the display graphics and access routines would need to take account of the needs of users with reading difficulties, or who are unfamiliar with computers and those with learning difficulties.

A number of these problems cease to exist when presenting information to users via personal information devices. There is a broad consensus that there is great scope for providing individuals with personalised travel information services. For example, personalised printed timetable information has been very favourably received by bus users. As the review shows a number of organisations have recognised the opportunities for electronic media and are now exploring the options for disseminating static, dynamic and even real-time information on a highly targeted personal basis. This includes the use of pagers and Nokia modems in organisers and mobile phones (as prices are falling fast). It is even considered to be feasible to provide pagers free providing they are also able to allow advertising.

This therefore seems to be an area where market implementation is quite feasible. Of course, the success or otherwise of such products or services will be strongly influenced by the intrinsic quality of the travel information supplied via these media.

Some examples of portable information systems are described in Appendix D.

6.4 Operational management

Fleet management telematics applications have the potential to offer operators improvements in operational efficiency and management decision making based on improved knowledge of vehicle location and delays. This can be used, for example, to improve the deployment and maintenance of vehicles. Similar technology is already used widely in the freight industry and is finding increasing favour in the coach industry. Local Authorities are willing to help bus operators gain the full benefits from such systems by, for example, using the same technology to facilitate bus priority at signalised junctions. However, with a few notable exceptions (e.g. Stagecoach in Manchester), outside London there is generally little interest from operators in implementing the technology.

Bus operators in urban areas only have limited influence over the delivery of the service. Traffic congestion, for example, is outside their control. Providing operators with improved information about events, upon which they are
able to take management action to improve service, is only a small part of a wider package of measures needed to improve performance. It is then a question of value for money for the operator from the investment in equipment purchase and maintenance. Some operators have found such systems difficult to keep up-to-date and well-maintained to ensure sufficient reliability to act as a useful management tool.

That said, anecdotal experience from Leicester was that an operator using this technology had been able to provide the same service on the same route with one less bus just by improving reaction times to problems on the network.

Although there is still some reluctance on the part of some franchise holders to use AVL technology to improve operational management, the situation in London is quite different. London Transport Buses has helped to establish a contractual and cultural environment in which operators are positive about implementation. Here the business case for investment was built around (a) contract management requirements for demonstrating service performance standards (b) improvements to operational management and (c) providing information to users via the Countdown system. LT Buses noted operators had experienced a significant learning curve in realising the benefits of operational management capabilities of the system because it represented a very different way of managing buses. Key areas of improvement were in regularising departure from termini and in demonstrating a commitment to service reliability. This facilitated the development of a partnership with the Local Authorities in tackling causes of problems and provided detailed information to Boroughs on actual performance.

Gathering a database of historical information about problems on the network also enables operations managers to predict likely difficulties in advance and take appropriate action. This approach, however, illustrates some of the cultural problems facing operators which lead to a reluctance to introduce such technology. Responding to predicted or known difficulties on the network impinges upon the management roles of the controller and scheduler, with the controller wanting to change the schedules to respond to current conditions. This may threaten the role of the scheduler who may be more reluctant to extend to the controller increased freedom to respond to changing conditions. This therefore represents a major technical change in the way the buses are managed in the context of changing management structures in an extremely cost-conscious industry.

Cultural change would be required at a very basic level too. For example, many bus garages are hostile and vulnerable environments, poorly suited for housing computers. Changes in management structure also mean that there are few staff available in a typical bus garage to operate such a system. Supervisory staff have been drastically reduced since deregulation and the remaining staff are responsible for dealing with operational issues at strategic nodes (e.g. bus stations) rather than being based in the garage.

The following section deals with some of the required technology for such systems, but with a few exceptions the technology is mostly used for bus priority and passenger information, rather than fleet management.

6.5 Bus priority systems and real-time passenger information

The review has identified a wide range of systems trials in progress. Nearly all of these involve automatic vehicle location technology which is used both to trigger bus priority at signalised junctions and to provide information which is disseminated as real-time passenger information. It is quite feasible to provide bus priority or real-time passenger information independently using different technology, but in practice it appears that the technology offers a single, accurate solution to both needs and the development of these applications is in most cases proceeding in tandem.

The results of trials undertaken so far have been mixed, both in terms of changes in patronage and in terms of improved reliability and journey times.

In considering the likelihood of implementation of such systems in the bus industry, one of the key constraints is the lack of common specifications (e.g. for interfaces) and industry-wide standards. This has led to a diverse supplier base without a clear market leader. Suppliers need to know a market exists for these products before committing further investment, but for the foreseeable future, many Local Authorities and operators will not contemplate investment in such technology due to:

- high investment costs;
- potentially short service life (if other systems are adopted as de facto standards);
- potential incompatibilities between systems operated in different areas served by the same operator’s bus fleet.

As the Bournemouth system shows, the investment costs need not be as substantial as in many of the trials reviewed in Appendix E. This at least provides an example of good practice which could be considered more widely in the short to medium term to provide a basic level of passenger information.

The risk-averse strategy of delaying implementation until the technology is mature is understandable, but it delays the start of the lengthy process of cultural change (in the bus industry and Government) as well as foregoing the interim benefits of improvements in service quality. For this reason, clearly focused demonstration projects, standards agreement activities and evidence of commitment from Government have a significant role to play in accelerating the process of technology migration.

The trials have tended to focus on key bus corridors, reflecting the particular interests of Local Authorities, whereas operators are concerned with providing services over entire networks. Practical constraints on bus scheduling and allocation of buses to routes therefore may mean that operators need to equip all their buses in order to provide information or support bus priority on only one corridor. In such circumstances operators would clearly prefer to see the systems implemented by Local Authorities on a greater scale. In addition, the trials have
often targeted corridors that are heavily used by buses in order to demonstrate the advantages of bus priority. Yet the high frequency of bus services associated with such corridors often means that bus passenger information can be superfluous to the user.

Only limited work has been undertaken on network-based bus priority and passenger information, including, for example, trials in Bournemouth involving Britech and Firstbus. If bus priority and passenger information are to be implemented more widely, further work will be needed on network-based systems which interface effectively with urban traffic control systems.

An early start will need to be made to the process of agreeing common specifications and interfaces between real-time passenger information systems operated by different modes. These have, until now, developed largely in isolation.

Examples of bus priority and passenger information systems are given in Appendix E.

### 6.6 Multi-modal ticketing and integrated payment

The technology used in the schemes includes several examples of magnetic ticketing and, although there has been much discussion about the use of smartcards and there have been a number of trials, there has been little in the way of widespread implementation to date.

Public transport ticketing has always been a relatively complex area. The privatisation of the railways and the deregulation of the bus industry have not helped to make the situation any easier. From the perspective of the user the level of choice continues to increase as the separate transport industries begin to develop trip- and mode-related packages and discounts. In many cases, for example by providing bus travel entitlement in the price of the rail ticket, operators are beginning to offer a free-market solution to the problem of complexity. Although this leads to patchy coverage, it is providing an effective focus on major urban networks (such as metropolitan areas) and key corridors. Long haul coach, rail and air travel are most effective in establishing multi-modal ticketing arrangements, as the elements of the trip made on another mode are often a small extra cost in the total price of the journey. The main problem lies in ensuring that the ticket itself will (e.g. if magnetic) work within the technological systems operated by the different modes.

Increasing integration in this area will require the development of common standards across all modes for ticketing media as well as, for example, reservations systems. There is likely to be an important European dimension to this development activity.

The current complexity of the ticketing arrangements reflects the underlying financial complexities in the transport industry and the segmentation of the market to maximise profitability. Measures to increase the convenience to users of ticketing arrangements arise following contractual agreements between operators and the establishment of revenue pools. As the number of participants increases and the pool grows, so the formulae for distributing the revenue become more complex, participants become more nervous over the inaccuracies of the distribution system and the pool system breaks down. This is a particular problem facing transport integration over the coming years.

In principle smartcards offer an intelligent solution to this problem by enabling detailed information to be captured from which the accuracy of revenue distribution could be improved (see Figure 5). However, much of the research into smartcard technology has been focused on the user and service aspects of the process (i.e. user acceptance of contactless, swipe or flash cards and their effects on boarding times). In principle there are real benefits to be realised by speeding boarding times, for example by reducing blockages in bus lanes, but in practice it appears that implementation is more likely to be determined by contractual issues between operators.

Another aspect of this problem is the role of smartcards in affecting the method of payment, which is essentially a marketing and customer convenience issue. Once magnetic readers are available on buses, it becomes a small step to move ticket sales off-bus and facilitate multi-modal ticketing.

The ticket is also a key factor in enforcement, providing information with which to verify the route taken and that a valid fare has been tendered. Any technology-driven replacement system would need to incorporate a similar and appropriate enforcement functionality.

The role of telematics is therefore not the key issue. Deciding what to offer the passenger is critical and this is influenced by institutional and cultural factors, uppermost of which is the equity and control of revenue distribution between operators.

Examples of multi-modal ticketing and integrated payment are described in Appendix F.

### 7 Barriers to realising the potential of telematics in public transport

#### 7.1 Need for evidence of financial returns from telematics applications

The public transport industry in the UK has undergone major organisational changes in the past ten years. It is essentially run by commercial operators who apply normal business practices to assess an investment opportunity. In considering a business case for any new technology, they will inevitably focus on the financial return. The whole industry is highly cost conscious and is naturally cautious about costly investments which may not yield direct financial returns.

Evidence from elsewhere in Europe, where much of the public transport industry remains in public ownership, suggests that there are fewer commercial risks to operators and therefore their investment is greater in telematics systems which may not, in themselves, provide financial returns, but which support the overall policy of integrated transport.

Telematics applications for public transport are unlikely, by themselves, to justify investment unless supported by a range of other measures which benefit public transport use, possibly at the expense of the private car.
7.2 Protection of markets
The nature of the bus and rail market (outside London) is competitive. This means that operators are generally concerned with preserving their market share from other operators. Initiatives to provide comprehensive information in the form of available services, timetables and fares information have not been well supported. Surprisingly, operators have not seen the provision of good information as an essential part of operating the service. This may be because asset management is a key element in ensuring profitability so that increasing or sustaining patronage may not always be a primary business objective, or possibly because most revenue is from people making regular journeys and these passengers have a limited range of requirements for information. With a general decline in bus use, there is a tendency to cut back on non-essential expenditure in an effort to retain the profit margin. For the industry to reverse this trend there may need to be some support for investment.

7.3 Lack of investment
Following deregulation of bus services and privatisation there have been periods of low investment in new vehicles and infrastructure. Indeed many bus stations were sold and vehicles required to stop in-street rather than in a dedicated bus station. There is considerable anecdotal and research evidence to show that investment in new vehicles and passenger facilities can generate significant increases in patronage. Investment, particularly in passenger facilities, is therefore the key priority in achieving regeneration. Operators may consider new telematics applications associated with investment in new vehicles, but will be highly sensitive to the cost of these. That said, the cost of retro-fitting would be an even bigger problem, especially if the telematics application depends on all vehicles being fitted.

7.4 Focus on cost minimisation
Public transport operators have traditionally worked on cost minimisation, rather than being focused on profit. They are averse to risk-taking and have small margins. New operators entering the rail market may have the appropriate conditions for investment, although even these companies will be cautious about new (prototype) technology which may need to be replaced before the full benefits are realised.

7.5 Bus service instability
7.5.1 Provision
In some areas services are still changing and this makes any attempt at providing comprehensive information very difficult. Installation of expensive telematics equipment on vehicles can only be justified if the vehicles will be used in the equipped area. Movement of vehicles between routes and possible changes to routes and services mean that operators may be unwilling to invest in telematics.
equipment. Trams have become more attractive recently and one reason for this is the inherent stability offered by a fixed track system.

7.5.2 Intervening stops
In registering a service bus operators are only required to provide times at key stopping points. Times of arrival at intervening stops are generally interpolated later and as such do not provide a reliable information base for passengers. To add to this level of ambiguity, some operators are also responsible for defining where these intervening stops are located and their name. This name can differ from that used by other operators. Different operators can choose not to stop at other operators’ stops. The passenger is left confused as to the name of the stop, its location and whether the service they wish to use will stop there. The situation is considerably more straightforward for the user where Local Authorities or PTEs have taken responsibility for the naming and siting of stops. Accurate identification and consistent naming of stops is an essential feature for any passenger transport information system based on a Geographic Information System.

7.6 Ticketing complexity
Ticketing has become increasingly complex as operators attempt to segment their market and to compete with other services. Fares can vary on particular routes by time of day and day of week. Where there are through-ticketing schemes offered these are often complex. Other European countries offer a much simpler range of tickets for use in a single integrated transport system covering all modes. However, this is only achieved with some financial support. Whereas through-ticketing is ensured in London via franchising arrangements, in other areas agreement must be reached between the various operators. This is a much more complex process in the absence of powers which make participation compulsory.

7.7 Different stakeholder objectives
Local and Central Government is generally interested in maximising patronage of public transport to reduce congestion and car dependency and maintain services for non-car owners. Yet the public transport industry in the UK is essentially run by commercial organisations whose operational practices are driven by the need to generate profit. This means optimising, not maximising patronage. Deregulation has anticipated the decision of withdrawing from unprofitable services by enabling Local Government to subsidise routes. However, operators are free to adjust their fares to respond to demand in such a way as to maximise profitability. This rarely equates to maximising patronage.

7.8 Competition from the car
The main competition for passengers is between public transport and the car. If car drivers are unconstrained, then public transport will continue to lose market share. However, if a general change in attitude and policy is brought about whereby society accepts the need for an increase in private motoring costs in order to support increased investment in public transport, investment funds could be made available to improve public transport services. Improving the quality of information would then naturally follow.

7.9 Lack of integrated planning
Public transport needs to form an essential part of urban planning. Public transport works best along dense corridors with major passenger flows. It is not effective at managing dispersed trips. For example, serving out-of-town shopping areas is difficult. On the other hand, town centre developments which have good public transport access will encourage people to use public transport. For example, Metrolink in Manchester.

7.10 Lack of standards
There are numerous different technical solutions being proposed for telematics applications. Operators have already found that systems have been superseded after a relatively short life. Given the levels of investment involved, there is a strong need for standardisation to bring stability and durability to this product-based market, particularly:

- specifications for common interfaces between different bus location and priority systems;
- interfaces between information systems;
- presentation of timetable information (across all modes) in paper and electronic forms;
- interfaces between other systems operated by different modes.

7.11 Need for further technological development
While most of the barriers to implementation have more to do with institutional obstacles than the need for technological development, it would be valuable to ensure continued development in the following areas:

- technological compatibility and interoperability of ticketing systems across all modes;
- development of software for accessing distributed information sources for trip planning systems.
Part II: User needs for travel information for journeys by public transport
8 Travel information for public transport users

8.1 Aims
In the preceding part of this report information was seen to be one part of a wider package which constitutes the service to the public transport customer. The following part of the report focuses specifically on improving information provision.

In order to effect a modal transfer from car to public transport one has to address the means by which the motorist might be influenced. One of these ways is to ensure that he/she is more easily able to plan a public transport journey regardless of the origin, destination, time of travel, mode(s) or the number of stages. The current methods of disseminating public transport travel information tend to assume that the potential user has sufficient information easily to hand in order to decide on the most appropriate way of undertaking a journey. This is not always the case. This review seeks to identify some of the problems experienced and ways these might be overcome through the use of telematics.

There is also a perceived need to provide a national public transport travel information system capable of supplying seamless information on all inland travel, including both national networks and local journeys. However, to be successful, such a system must reflect the needs of users. Through an assessment of user needs, this review also aims to determine the extent to which a telematics based trip planning system, covering all modes of transport, can contribute to the development and integration of public transport systems.

This part of the report will aim to identify the information that would be important to various user groups as well as when and how it is best collated and provided.

8.2 Scope
This review is concerned with:

- passenger trips made entirely within the United Kingdom;
- information needs of the traveller for journeys within and across different regions, companies and public transport modes;
- single and multi-stage journeys of different types (e.g. to school, work, shop or on holiday);
- the needs of different user groups, particularly those who are not currently regular users of public transport and considering the special circumstances of financially and physically disadvantaged groups in society;
- the breadth of information required for trip planning (including timetable, fare and interchange information) as well as real-time in-trip information;
- identifying the barriers to the provision of accurate, timely, accessible, comprehensible and clear information as well as the potential role of telematics in overcoming these barriers and facilitating its dissemination.

9 User needs for public transport travel information

9.1 Basic requirements and definitions
In the context of this study ‘user’ is synonymous with ‘customer’ and ‘travelling public’. It is worth noting, however, the existence of other user groups for public transport information including the travel trade, transport staff and the friends and relatives of users who, for example, meet them at interchanges.

There are certain general criteria that all information must meet in order to be of use to users:

- accuracy - is the information correct today, now, for the journey that is about to take place? Technology can help to improve the accuracy of information, for example through automated data collection, logging and dissemination and the use of intelligent systems. However, all information costs money to collect, even that gathered remotely.
- accessibility - can the information be located quickly and easily? are the means of dissemination available to all users in convenient locations (e.g. on return as well as outward journeys)?
- timeliness - is the information available in time to be able to use it effectively? (particularly for dynamic information for trip planning and real-time in-trip information).
- comprehensibility - can the information be understood by all the users? is it too complex? is it presented effectively to aid comprehension?
- comprehensiveness - is all the relevant information available and seen to be available? is there any perception that information about services available from rival operators on the same route has been withheld? are realistic alternatives in terms of modes and route options covered?

Other definitions
Information is required both pre-trip for planning purposes and in-trip for understanding and responding to unplanned changes. In addition, information can be categorised as:

- static - (i.e. scheduled, such as a timetable);
- dynamic - (i.e. unplanned, such as railway strike, airport fog), but in a timeframe which in principle allows adjustments to trip plans; and
- real-time - (i.e. unplanned up-to-the-minute information, e.g. about delays or problems) in a timeframe which means it is likely to disrupt the trip and may require modification of journey plans en route.

9.2 User needs by type of information
9.2.1 Trip planning information
See Section 6.2 for a discussion of technologies and Appendices B and C for practical examples. Elements of Section 6.6 on multi-modal ticketing and integrated payment are also relevant.
**Static information**

Users need basic, static information for trip planning purposes. The way information is presented and the types of information included (particularly on timetables) differs between modes. To be able to consider all modes on a common basis it has been necessary to identify five basic categories of trip planning information:

- time information (e.g. departure times, frequency);
- service information (e.g. bus route, train number);
- fare information (e.g. fares, tickets, special offers);
- interchange information (e.g. departure or alighting points, facilities available);
- bookings information (e.g. availability of seats).

**Dynamic information**

In so far as users may have the option of selecting different modes to reflect changing circumstances in the short term (e.g. fog at airport, strike on railway, crash on motorway) users have a need for dynamic information to inform trip planning decisions. However, in each of the circumstances and modes where this applies, it is likely that the need for pre-booking well in advance of the trip is likely to affect the true freedom to change modes at short notice to make best use of such dynamic information. See also Sections 6.3 and 6.5 for details of the relevant technologies and Appendices D and E for examples.

**9.2.2 Real-time in-trip information**

Users have a need for real-time in-trip information (e.g. unscheduled events, delays) for modifying journey plans en route, where possible, and for ease of mind based on an improved understanding of current operational circumstances. For a discussion of the technology see Sections 6.3 and 6.5 and for examples see Appendices D and E.

**9.3 User needs by location of information**

The information needs of a user on the outward leg of a journey can be very different from those on the return trip, when access to sources of information can be much more restricted and dependent on the current mode of travel. There is much less perceived need for information once journeys are under way, although again in-vehicle information about forthcoming stops is welcomed by users and may help to reduce waiting times at stopping points. Advice on alternative routes in emergencies or during operational crises is also highly valued.

Journey planning needs lead to a requirement for printed material or some form of enquiry service in homes and, for the return journey, other locations (e.g. places of work, hospitals, shopping centres). Telephone enquiry services are becoming more common and well appreciated, but they are not used by many people, possibly because they are not well known, possibly because they are most useful for planning long or irregular trips, rather than short or regular trips. They can also be expensive to operate and premium call costs may deter some potential users.

Information at bus stops is considered helpful in indicating where to wait for buses, routes served and departure times. Passengers appear to appreciate real-time devices which indicate how long they may have to wait for the next bus, tube or train (provided systems are reliable). It has yet to be demonstrated robustly that such systems affect demand on buses. Where resources are limited, people would seem to prefer provision of low-cost, low-technology information displays available at journey ends and at stops, rather than investment in high-cost, high-technology devices at a limited number of places (e.g. see Balcombe and Vance, 1997).

Direct interrogation of computerised information systems through computer terminals is technically possible, but in view of the cost of such units and the evidence of low levels of utilisation by users, is financially questionable at present. High investment costs mean such terminals could currently serve only a small proportion of the total public transport market, and may prove difficult for would-be bus travellers who do not know the names/codes of stops most convenient for their actual trip ends. Utility is perhaps greater at rail and air interchanges.

It is also important to recognise that the location of trip planning aids can easily affect their usefulness in delivering transport policy objectives. A bus route planner available only at bus stations is very unlikely to deliver modal shift, but may improve the quality of service to existing customers. Even where such systems are located in a general sense in a useful location, such as in a shopping plaza or an airport concourse, the success of such terminals will be critically dependent on location to within a few feet of a specific point. This reflects the unconscious needs of users to access information in a convenient location.

**9.4 User needs by user group**

**9.4.1 Local and regional variation in needs**

There are some local and regional variations in public transport user requirements and priorities for travel information. It is not clear what causes these variations. In an ideal world these differences would be reflected in the way information is provided in these localities. However, such an approach could undermine the objective of providing simple, clear, comprehensive and accurate travel information about public transport services for journeys which span more than one such area.

**9.4.2 Needs of potential users: car drivers**

To achieve any level of modal shift from the private car to public transport will, almost by definition, involve considering the needs of users who do not currently use public transport to any great extent. Little research appears to have been undertaken on the potential information requirements and priorities of those who are not currently regular public transport users. These potential users may in many cases be different from existing public transport users (e.g. purchasing power, time pressures, attitudes, travel objectives) and have different information needs (e.g. motorists are likely to have a very low level of knowledge of a public transport network and are probably not even aware of the location of bus stops in their immediate area or the services that operate from them).
Many people will experience difficulty in extracting information on routes and service times. This leads to extreme difficulty in dealing with multi-modal travel information. So, while their information needs may differ from those of existing users, it is necessary to assume at this stage that they have similar information needs to all new users of public transport systems - about whom a little more is known.

The key message here is that new users require substantially more information on a broader range of subjects than regular users. Any difficulties in accessing or understanding that information are more likely to discourage them from using the service again. Effective information provision therefore has a crucial role to play in facilitating modal shift.

In this regard, Australian research has indicated that understanding timetables and other travel information is much improved when users understand more broadly the transport system they are using. For example, if people cannot see interconnections on a route they are unlikely to use them. Simplification of service information to improve presentation may lead users to form an incorrect understanding of the system and fail to obtain the full potential of the system on offer. This general conclusion would explain the vast variation in information requirements between those who use a system frequently (and who have an improved familiarity with and understanding of the system) and those who do not. There may therefore be merit in simple educational activities to improve users’ understanding of how transport modes operate and the way this impinges on what they experience.

To make the public transport system more comprehensible to motorists (who are likely to have a very different geographical perspective from public transport users) timetable information providers could do more, using technology, to link bus and rail stops to postcodes, street names and major facilities such as rail stations, leisure centres, etc. so that an area of influence can be identified for each stop. Having identified the nearest node within the public transport network one can then use this information for the planning of a journey. The same can be done for the ‘disconnecting point’ at/near the destination. An example of just such a ‘landmark’-based approach to journey planning has been developed by Community Technology (see http://ct.elmail.co.uk/bucks/index.html). Development of these types of telematics applications could therefore play a specific role in helping to provide the high level of support required initially by motorists.

If they transfer to public transport and leave their car at home, motorists also need to have confidence that whenever they arrive at an interchange they will be able to continue their journey regardless of their time of arrival. This is why some motorists drive to rail stations and park and ride. If one were able to ensure that commuters could depart for their ultimate destination whenever they arrived at the station they might be more inclined to use public transport for the whole of their journey. Telematics could help address this issue by using uniquely encoded individual tags to automatically plan the onward element of a journey by public transport.

9.4.3 Financially disadvantaged users

A significant proportion of today’s public transport users are financially disadvantaged. Public transport generally and concessionary fare schemes in particular provide them with access to improved mobility. If the Government’s underlying objective of ensuring a socially inclusive transport system is to be met, improvements to the public transport systems and information provision must not be allowed to push up costs to all users such that the financially disadvantaged cease to have access to transport. This implies that:

- investment by industry in telematics systems and information collection does not increase fares;
- public transport information should be available free of charge. Although the costs may fall substantially over time, access to the internet is not free of charge in the UK.

Existing funding mechanisms, such as concessionary fare schemes, could in principle be extended to meet such increases in travel costs to the user. Ultimately, however, this implies an increase in Government expenditure.

9.4.4 Technologically disadvantaged users

A significant proportion of today’s public transport users are also technologically disadvantaged. The elderly, people with learning disabilities and those generally unfamiliar or uncomfortable with computer-based technology are at risk of being excluded from the gains likely to be forthcoming from the development of advanced telematics applications for public transport trip planning. It is important, therefore, to ensure that such information can be made available in ways which are acceptable to these users, for example via telephone enquiry services which have access to similar journey planning systems.

9.4.5 Physically disadvantaged users

The information needs of physically disadvantaged people are more extensive and detailed than other users and are largely related to the nature of the physical impairment. Interchanges present a particular problem. Users need to know, for example:

- the general layout for navigation purposes (e.g. for the blind or those who will be racing against time to reach a connecting service);
- the existence and location of potential impediments (e.g. steps, turnstiles);
- the precise location of facilities for the disabled (e.g. ramps, lifts, suitably equipped toilets);
- the scheduled interchange time allowed for connecting services (i.e. whether they are physically able to travel the required distance in the time allowed);
- the general quality of facilities and awareness of the needs of the disabled (e.g. signing, voice messages, staff availability to provide assistance, accessibility of ticket dispensing machines).

Users need information about vehicles too. The varying makes and models of bus and train rolling stock differ in
their accessibility to wheelchair and other users, but pre-
trip information is rarely available about which services use
which vehicles. Users have to learn by experience. For
example, low floor buses have been particularly successful
in meeting the mobility needs of some users. However, they
are not universally available on all routes, which means that
users need to obtain information about when and where
such services will be available, or simply try it and see.

9.5 User needs by type of journey
In the context of policies to deliver modal shift from car to
public transport, the majority of enquiries are likely to relate to
journeys of less than 10 miles as 79% of car journeys are in this
category. This is likely to involve journeys which are
predominantly by bus. One of the key constraints on making
long distance multi-modal public transport journeys is the
difficulty of obtaining information about the public transport
links to and from the departure and arrival points for the main,
long distance element of the journey (i.e. to and from the
station at each end). It is therefore very important that travel
information is available between any two points in the UK.

Journey purpose affects the travel objectives of the user and
therefore their information needs:
- a business trip might be driven by the need for
  punctuality of arrival time;
- the shopping trip by flexibility of departure time, the
  relationship between fare and parking prices and the
  scope for managing heavy baggage;
- the holiday trip might be driven by the most scenic route
  and absolute fare;
- the commuter trip by the fastest route and the fare
  structures for frequent users (e.g. season tickets).

In principle, one person could make all these trips in one
week. The information needs even of the same individual
are therefore highly variable.

9.6 User needs by mode
9.6.1 Buses
The vast majority of regular and occasional bus users say
they require no information, while a large number of new
users (which is likely to include those travelling outside
their normal pattern) say they require a wide variety of
information (see Table 4 (Balcombe and Vance, 1997)). Of
those regular and occasional bus users that do require
information, their priorities are mainly for:
1 timetable information (departure time, frequency, arrival
time and journey length);
2 service information (bus number and route - often
included in printed timetables);
3 interchange information (boarding and alighting points);
4 fare information.

Table 4 Information needs of bus passengers
(\% travellers requiring each type of information)

<table>
<thead>
<tr>
<th>Information type</th>
<th>Regular</th>
<th>Occasional</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Departure time</td>
<td>18</td>
<td>31</td>
<td>79</td>
</tr>
<tr>
<td>Frequency</td>
<td>6</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>Bus number</td>
<td>5</td>
<td>9</td>
<td>61</td>
</tr>
<tr>
<td>Fares</td>
<td>3</td>
<td>6</td>
<td>39</td>
</tr>
<tr>
<td>Arrival time</td>
<td>3</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>Route</td>
<td>2</td>
<td>3</td>
<td>39</td>
</tr>
<tr>
<td>Journey length</td>
<td>2</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Boarding point</td>
<td>1</td>
<td>3</td>
<td>53</td>
</tr>
<tr>
<td>Alighting point</td>
<td>1</td>
<td>3</td>
<td>48</td>
</tr>
</tbody>
</table>

Booking information is not usually relevant to bus travel
and real-time information is rarely available, particularly
in-vehicle. These needs reflect the fact that the price of travel by
bus is comparatively low so that value added trip planning
services are not generally available to travellers, who must
therefore obtain and analyse correctly all the information
themselves. Interestingly, much of the bus information
currently provided is very little used by the public because
they are unaware of it, cannot easily obtain it or cannot
understand it. While timetable information is the most
valuable to travellers, many people are unable to use standard
timetable information effectively for journey planning.

The extent to which users expect accurate information is
conditioned by experience in travelling by the transport
mode. This is particularly relevant in the bus industry.
Experienced bus passengers pay less attention to
timetables because through experience they have come to
understand the level of variability in actual performance.
In addition, once service frequency falls below about 5
minutes, a timetable becomes irrelevant and only
frequency information is needed.

9.6.2 Rail
As with the users of buses, regular rail passengers have a
much more limited requirement for information than new
passengers. Once the general level of information required
exceeds a certain level of complexity, users will usually seek
help or reassurance from railway staff. Infrequent services,
the role of connecting services and long distances without
easy alternative modes of travel mean that there is a high
perceived penalty of missing the service, and time
information plays a dominant role in user requirements. Fare
information is also much more significant than on buses as
the amounts involved may be two orders of magnitude
higher. In particular, with the subdivision of the railway
system between a multiplicity of operating companies, each
with its own fare structure, the ability to choose a route with
the lowest fare may be important to many people.

The information priorities of rail users for trip planning are:
1 timetable information (departure time, frequency, arrival
time and journey length), which for many is the only
piece of information required. The situation is slightly
confused, however, by the mandatory requirement for rail
timetables to include information about services (see 3);
fare information on its own is generally used to inform a mode-choice decision, but usually fare information is required in combination with times since there is a strong iterative link between them;

3 service information provided on timetables includes availability of classes of accommodation, refreshments, and optional / compulsory reservations. The availability of smoking facilities may also be pertinent;

4 booking information is often a subset of fare information and the two may be inextricably linked, for example through Apex fares;

5 interchange information. In trip planning much of the demand for interchange information is a subset of time information (e.g. how long will it take to reach the connecting service ?) and for checking facilities and provision for physically disadvantaged users.

Static in-trip information needs are likely to place a much higher priority on in-train service information and also on interchange information, most particularly platform numbers.

Reliable real-time in-trip information is frequently available, most particularly for notification of late running and service problems. This information is collected for a number of other important reasons not relating to passenger information provision, but clearly has added commercial benefit to retailers on trains and at stations. Value added trip planning services are available but are most likely to be used by travellers investing in longer trips. Other travellers must obtain and analyse correctly all the information themselves. As with buses, it is interesting to note research indicating that most rail passengers do not want to consult timetables, which in general they do not trust or are afraid of using for fear of making mistakes.

9.6.3 Coach
The position of coach services in the travel market are mainly as a low cost alternative to rail for inter-urban journeys. Demand is greatest from cost-conscious commuters, holiday-makers, students and the elderly. Mode choice is primarily determined via fare information which is therefore a high priority for new users. This is significantly different from the user needs for bus travel. Interchange information is also significant for the new user group who initially may not be familiar with the location of coach stations or stops in urban areas or the facilities available.

All users place a high priority on timetable information and, where relevant, booking information. Information about services and facilities available en route (either onboard or at break points in the journey) are also of value, particularly to certain user groups such as holiday-makers and the elderly.

Although there are qualitative differences, there is no reason to believe that the information needs of regular and new users of coaches are quantitatively any different from users of other passenger transport modes.

9.6.4 Ferry
Information needs for travel by ferry are critically dependent on whether the user is likely to employ the services of a booking agent, or to undertake the planning themselves. The diversity of ferry services within the UK is such that this will depend entirely on the specifics of the crossing itself: the frequency of the service, its cost, whether the trip is likely to be a commuting trip or a holiday trip and whether the traveller is taking a vehicle with them (e.g. bicycle, motorcycle, car).

For trips where booking is mandatory and usually undertaken through an agent, the information needs and priorities of the user are likely to be comparable to those for air travel. Interchange location is unlikely to be important except in so far as precise directions may be needed for access by car. There is likely to be a timetable of services, but this is generally likely to be available only through booking agents. For trips where booking is not necessary, regular and occasional users are thought unlikely to require any information. New users making the ferry trip as one part of a public transport journey may be unlikely to require any information (and may even be unaware that a ferry trip is part of the journey) because the public transport operators servicing the ferry interchanges provide any such information (including inclusive fares) at the time that the user arranges the journey with them. Where this is not the case, new users place a higher priority on fare and time information than interchange information. Service information is likely to be much less relevant than in other modes.

9.6.5 Air
The cost of air travel is comparatively high, so there is scope in the market for businesses providing value-added trip planning and booking services. In many cases it is not therefore necessary for the general public to be able to access and comprehend information about air travel within the UK. The users of such information are largely travel agents who can be trained and who can remain familiar with the information through repeated use.

With high ticket costs and with high penalties for missing a flight (e.g. caused by infrequent services), it is thought that a high proportion of all users will require some information. As with buses, it is likely that information priorities for regular and occasional users will differ from those of new users. However, they are likely to be limited in most cases to booking information to confirm availability. This is particularly significant because all remaining information necessary to make the journey is generally available on the ticket itself.

In considering modal choice options the new user needs interchange information (existence and location of airports), and fare information (approximate, relative to other modes). The travel agent would then need to confirm timetable information to satisfy the arrival and departure time needs of the user and booking information (to confirm availability, class, seat (e.g. window, non-smoking)).

Service information is not relevant to trip planning, but is very important on arrival at interchanges. Real-time information is generally widely available before departure, but once in flight there is little that the traveller can do to take account of unforeseen events. Delays in flight are also limited by safe operating requirements.
9.6.6 Multi-modal

A recent study of modal interchange activity commissioned by DETR concluded that in 1993-5 interchanging trips (where the traveller changes vehicle or mode during the journey) formed:

- 2% of all journeys;
- 0.4% of car journeys;
- 3% of all bus journeys;
- 65% of rail journeys;
- 30% of journeys on London Underground.

In general terms, given that the same survey identified that 83% of all journeys were made by car then about 10% of all non-car journeys involved interchanges. Given that a considerable proportion of these interchange movements will be within mode (e.g. rail to rail), it can be concluded that multi-modal public transport trips constitute a relatively small proportion of public transport journeys.

Providing multi-modal travel information will therefore meet the needs of relatively few existing public transport users, although there may be more potential users who would become users, and benefit accordingly, if the information became available.

However, one of the key routes for encouraging motorists onto public transport and increasing their level of familiarity with the systems will be via multi-modal journeys involving the car, so this is nevertheless an important area to consider. It is also a key tool in managing traffic demand on particularly congested links.

The quality and presentation of public transport information at car-bus (park and ride) and car-rail (park and rail) interchanges is therefore of key significance in encouraging modal shift.

As several modes are linked together timetabling, ticketing and interchanges become key, as are management strategies in event of delays on any one link in the journey. The complexities of each mode, which are just about manageable within that mode, are compounded across several modes to make journey planning (particularly) an order of magnitude more complex for the user.

A simple solution to this problem is to present a multi-modal journey to the traveller as if it were a single mode journey, by arranging contractually for the interchange to be facilitated both in time and ticketing / fare payments. This approach is becoming increasingly common, as particularly rail operating companies develop commercial relationships with bus operators to offer a range of new destinations as ‘virtual rail stations’ served by bus from the rail terminus. Ferry stages also form part of some bus or rail timetables without it necessarily being obviously the case to the user. In such circumstances, the user needs are generally the same as for the single mode journey, although where the user becomes aware of the multi-modal nature of the journey, fare and through-ticketing arrangements will be a high priority information need.

Another solution is to provide users with ‘on-demand’ public transport services. The obvious example is catching a taxi from the rail station to the destination. This removes the problems of working out the timing of the journey. Assuming taxis are normally available to meet arriving trains, and since booking and ticketing are not normally an issue, it is only the unpredictability of the fare (and for some the absolute level of cost involved) which act as an impediment. This assumes, of course, provision of clear information at interchanges about the location of taxi ranks and a means of calling a taxi in the event that there are none available to meet the train.

Where such convenient contractual mechanisms are not in place the amount of information required is several times greater than for travel by a single mode, so that qualitatively the user needs will be met by focusing on the bare essentials of time, fare and ticketing. Even for this basic information the complexities are such that the process is usually an iterative one. Travel objectives become key to determining the route of the iteration. For example, if the highest priority is speed, but departure time is flexible, the user will need to consider the best available connections between the fastest services on each mode. However, if departure (or arrival) time is fixed, the user will need to understand routing options in each mode and interchange points between the modes. If the priority is economy, the user will need ticketing and fare information for each mode and the restrictions which pertain to them (e.g. time of travel) before combining across modes.

Coping with this level of complexity in planning requires a good level of understanding of the individual modes and sources of information. Perhaps not surprisingly it is often obtained as a value-added service from a travel agent.

9.6.7 General summary of user needs

In order to facilitate trip planning and trip making activities by public transport, it is very important that information should be provided at a time, in a place and in a way that meets users’ needs. In analysing these needs more closely, however, it is clear that public transport users require a wide variety of information, at different times, in different places and for different reasons. Specific user groups have very specific and exacting needs, yet even the same person may require very different travel information on two different trips. Much variability in travel information requirements is also driven specifically by the mode of transport selected, although there are general trends, such as the relatively high importance attached to time-related information.

Figure 6 illustrates how mode-based information reinforces the user’s perception of public transport as a complex system, and how information systems which meet user needs can reduce this perception.

To address this complexity of needs, a public transport travel information service will need to access a comprehensive and accurate range of information, yet present it in a way that meets the unique requirements of the user at that moment in time. This will require a very flexible system capable of quickly identifying the user’s needs and circumstances and responding with appropriate information.

This obviously requires a clever information system, but also access to comprehensive and accurate information and the means of disseminating it effectively. The following sections will now consider these latter issues.
10 Current practice in the dissemination of public transport information

10.1 Overview
The success of an information dissemination process is dependent on:
- content (e.g. time, service);
- medium (e.g. paper, electronic, voice); and
- location (e.g. at home, point of sale, in-vehicle).

If any one of these factors is wrong, the dissemination process is severely inhibited. While dissemination is also dependent on timing, this is usually less relevant for trip planning information. Most public transport travel information is made available on paper, although there is an increasing trend towards provision of static information by electronic means.

Part 1 of this report contains a significant amount of information about current dissemination activities and trials in progress, particularly in Sections 6.2, 6.5 and 6.6. Rather than repeat that information, the following sections consider more generally the issues influencing current dissemination practice, based on the understanding gained from this earlier review.

10.2 Information content
The issues surrounding the content of public transport information are discussed in detail in Section 11 on Sourcing Information. This section provides a general introduction from the point of view of the kind of information that is disseminated at present.

In general most public transport operators publish on paper information on the routes and the times of the services they operate. A few incorporate details of services by other modes (e.g. Railtrack also publish times of some ferry and bus services). Some also operate a telephone enquiry service. There is evidence that some operators do not publish the times of other operators’ services along the routes they share (e.g. Great Western does not publish in its timetables details of services operated by Thames Trains between London-
Oxford-Worcester; Great Western does not publish details of services operated by South Wales and West Trains between London-Swindon-Cheltenham in its timetables; Silverlink does not publish in its timetables details of Virgin and Connex services between Watford and Milton Keynes). This practice is more prevalent in the bus than the rail industry.

To our knowledge no bus operator publishes its fare information because commercially orientated operators need to be able to adjust fares, sometimes at short notice, to optimise patronage, income and costs.

Public Transport travel information providers rely on many operators providing information in different formats, which is current for different periods, using different names for some commonly used boarding points. User needs are therefore much more likely to be met by the adoption of a standardised format (printed or computerised) for timetable and, possibly, fare information.

Each operator’s disparate public transport network provides a range of destinations that can be reached by its services directly or by interchanging between its services. If all other public transport operators’ networks were overlaid there would be more travel opportunities than any single operator can individually provide. The current problem is that in most areas of the country it is extremely difficult for the public to determine how they might take advantage of these new travel opportunities that are created by being able to reference all operators’ timetable information. The areas where this is not likely to be the case is London, where all bus services are franchised and there is a central timetable information telephone enquiry service, and PTE areas where they have a responsibility to plan co-ordinated public transport services.

A problem common to both the rail and bus industries is the practice of operators taking responsibility for the printing and dissemination of selective timetables, for example for individual routes. Users often believe that the information is restricted only to the services of the named operator (which sometimes it is) and is therefore not even comprehensive for their route. The cause may be straightforward competitive practice in some situations, but in some cases it is known to be because information about other operators’ timetables is not available to the timetable publisher.

Given the general adoption of paper as the favoured medium for provision of information, this section focuses principally on the increasing role of and interest in electronic media, and the internet in particular, as a means of disseminating passenger transport information.

10.3 Distribution medium and location
There is a strong interaction between choice of medium and location. These issues are therefore considered in tandem in the following sections.

10.3.1 Paper
Most public transport operators and many Local Authorities and PTEs disseminate static information by paper. This is normally restricted to timetable and service information. Printed timetables are normally only valid for a fixed time period and are therefore reissued several times each year.

One of the main challenges in presenting travel information to users is the need to provide comprehensive information in a simple, easy-to-understand way. This careful balancing act requires the pruning away of superfluous material. The task is made more difficult by the use of paper as the primary dissemination medium. This effectively requires that the publisher must choose an average level of simplicity and an average level of comprehensiveness to try to meet the needs of as many customers (actual and potential) as possible in one printed document. The alternative is a plethora of printed documents tailored to meet the needs of smaller groups of users (e.g. specific route information only). Further confusion can be caused, especially in the bus industry, by the publication of overlapping information by a variety of interested parties, e.g. operators, local authorities, PTEs. The medium may also be inappropriate because of the rate of change of the information. This is particularly true in the bus industry.

The examples of best practice in using paper to disseminate timetable information are greatly outweighed by the examples of poor practice. A good example of an innovative approach to producing simple comprehensive bus information in leaflet form is provided by ULTRA, the public transport authority for the city of Umeå in northern Sweden. All the services for this medium-sized town are described in one leaflet (on approximately four A4 pages) and, in conjunction with the one page route map, provide all the information necessary for bus travel in the area. Other good examples of this minimalist approach may be found on bus stop displays in the Netherlands. The route, on which the stop is situated, is described diagrammatically in a line diagram, and departure times of buses from the individual stop are listed. This is very easy for passengers to understand, even those who are unfamiliar with the area or the route. It should be noted that the institutional, regulatory circumstances and the pattern of travel demand in Sweden and the Netherlands within which such systems can be operated may be very different to those in the UK.

However, research (Balcombe and Vance, 1997) has shown that many people are unable to use standard timetable information effectively for journey planning, and feel more confident if they can make contact with someone who can answer specific questions. Telephone enquiry services tend to be well appreciated by those who have used them, but often only a minority of travellers are aware that they are available. A good example is the multi-mode service operated by London Transport, which, it is claimed, generates sufficient revenue from public transport journeys that would not be made without it to pay for itself.

The way printed timetable information is presented is highly variable. Presentation guidelines are being developed by the rail industry. They already exist in the bus industry and cover a broad range of features (e.g. layout, symbols, font, font size, incidental information). They focus in particular on providing for the needs of users who may have difficulties reading printed text. In practice very few printed bus timetables comply fully with these guidelines. This is a
contributing factor behind the inability of many bus users to utilise printed timetables effectively. It is not clear to what extent the guidelines developed in the two industries are consistent, although clearly from the point of view of users, they should be.

In considering multi-modal trip planning, existing printed timetables suffer from a number of drawbacks which include:

- levels of detail about time and service information vary within and between modes;
- great diversity of timetables within modes. e.g. for buses, every local authority / operator presents timetable and other information in a different format;
- guidelines for the presentation of information in the bus industry differ from those in the rail industry. In this respect, they are not written from the perspective of the multi-modal user;
- while guidelines and standards exist, they are rarely implemented in full;
- even with guidelines, passengers cannot understand standard bus timetables;
- user perception of comprehensiveness of timetables is affected by the title (e.g. ‘summary of services’) and inclusion of information about or branding by private sector operators (does it cover other operators?).

Ensuring that people have the information they need, when they need it, can pose problems. Travellers making new or occasional journeys tend to need details of routes and timings before they set out on journeys, and may not have ready access to bus stop information (where it is provided) or travel enquiry offices etc. It can be very costly to maintain a supply of up-to-date, comprehensive information to every household in an area, and, in view of the proportion of people who actually use the information, quite wasteful. On the other hand, people who wish to acquire published information often find that it is difficult to find, involving visits to bus stations, enquiry offices or other places they do not normally frequent. Hertfordshire County Council has addressed this problem by establishing a network of distribution points, largely in retail premises, but also in public libraries etc., and appointing agents who are responsible for replenishing stocks and keeping them up to date. In Buckinghamshire timetables are distributed through the newspaper wholesalers who supply retail newsagents. So if paper is such a difficult medium to use effectively, why is it still used? Paper is a popular medium amongst those users who seek information. It is cheap, portable and easy to place in all locations pertinent to the trip (e.g. at home, at destinations, at intermediate stopping points, on vehicles). It has to be said, however, that frequently there are no alternative means of finding out information available. It is also cheap for operators and local authorities to supply, with low investment costs.

10.3.2 Telephone
Providing convenient access to most available static information at a small cost, public transport telephone enquiry services are becoming increasingly popular sources of information. Most are provided by transport operators, local transport authorities and, effectively, travel agents. The systems rely on skilled and knowledgeable staff accessing information either from paper or electronic systems to meet the specific needs of the enquirer. The cost of accessing the information is normally limited to the cost of the telephone call. Some enquiry lines are based on premium call lines. It is claimed that this alone generates sufficient revenue to meet the cost of providing the service, irrespective of changes in fare revenue. Other providers use local call lines. Depending on the specifics of the system and the regulatory environment in which it operates, the revenue generated from calls and increased fare revenue may cover the cost of providing the service.

Such systems are popular with users because of the person-to-person interaction. However, users and some enquiry line staff may have an inappropriate level of confidence in accuracy of the information provided via this exchange. Enquiry line staff also vary in their knowledge and understanding of the systems and therefore offer different levels of service. A key issue is also the diligence required of staff to find out less accessible information, for example on detailed engineering works and their likely effect on the enquirer’s journey. The enquiry lines can only be as good as the information they have to hand and the quality and motivation of the staff they employ.

10.3.3 The internet and electronic media

The internet
It seems very likely that the internet will have a key role to play in future in providing access to electronic information. A detailed review of the current role of the internet in the dissemination of public transport information is provided in Section 6.2.

The role of the internet as a mass information system is increasing rapidly with the increasing home ownership of PC systems and increasing number of people with at least casual access to the internet, for example at work. As a medium for disseminating information, the internet has the main benefit over printed timetables of providing access to information from anywhere in the country. This includes not only geographical areas that previously would not have had access to the printed information (e.g. bus timetables are normally only distributed locally), but also other locations that would not normally have held such data (e.g. offices, schools, colleges).

Electronic media more generally
In principle electronic systems can be designed to retain and access quickly fully comprehensive information, while the interface with the user can be tailored to provide varying levels of complexity depending on their capabilities. Because the system can operate dynamically, it can quickly home in on information relevant to the individual and their trip. This provides the user with confidence in the information provided and allows them to move on to gather and assimilate more information on other aspects of the trip. In many respects the telematics system has the ability to offer a dialogue similar to that with a person at an enquiry desk.
Electronic timetables have advantages for both the consumer and operators. Timetables can be updated instantly without the lag time associated with the printing and distribution of timetables, so improving the accuracy of information. Personal timetables can be generated for specific enquiries without having to sift through large books of timetables. The main advantage for operators is cost saving. Once the system has been set up, people will be able to use the system and print out the relevant information they need, eliminating the need for large numbers of hard copies of timetables and a reduction in personnel required to handle enquiries.

With increasing use of computers and familiarity with electronic media in the general public, particularly amongst those who are to be encouraged to change modes, it seems likely therefore that electronic access to public transport information for trip planning will be the way forward in the long term.

This makes it important to consider the potential impediments to the development and successful implementation of electronic public transport information systems. These are summarised as follows:

- relative to paper, electronic media are less popular with existing users with the potential to disenfranchise those who are unable or unwilling to use computer-based media;
- expectation amongst users that, since it is much easier to store large quantities of data, all relevant information will be available immediately for local, regional and national services;
- expectation amongst users that, since it is much easier to keep computer-based information up-to-date, the information provided will be current (though not necessarily real-time) at all times (i.e. it will take account of all planned events, such as rail engineering works);
- high investment cost to develop and maintain, with very different financing mechanisms;
- information not currently portable for most public transport users and difficult to obtain access to electronic information in all locations pertinent to the trip.

Since deregulation, bus services have been bunching around times and locations where loadings are viewed to be the highest, in direct competition with other operators. Some operators have shown little interest in providing timetables or adhering to them. Instead of providing detailed timetables listing arrival times at all stops there is an increasing trend for some bus operators to provide only a frequency guide for services at bus stops. Even where good quality bus timetables are available, one of the main problems facing electronic media is the initial expense of computerising timetables, especially in the bus sector outside London. However, as discussed in Section 6.2, local authority initiatives mean that 60-70% of these are already computerised or soon will be.

The problems for electronic rail timetables are less severe as the central database of timetables is still maintained by Railtrack after privatisation. This was necessary as ticketing machines need to access these data for route and price information. This has enabled the setting up of an on-line Railtrack journey planner which gives the quickest route between two stations, but there is no information on fares. This system also has a few local bus and ferry services to facilitate a multimodal trip planner to a limited number of destinations not served by rail. The database is updated daily, but some timetable information can change only days before the day of operation because of engineering work. The rail industry expects to have moved to a rolling 12-week schedule for such alterations by Summer 1998.

11 Current practice in the sourcing of public transport information

11.1 Overview

The extent to which information (e.g. times and fares) is accessible, timely and easy to understand is largely a function of dissemination processes. However, to meet user needs, the basic requirements in sourcing information are that it should be sufficiently

- accurate; and
- comprehensive

to meet the broad range of user needs identified above. Using telematics technology to distribute inaccurate or incomplete information will provide no extra benefit to users and will quickly become discredited. It is therefore important to address the causes of inaccuracy and incompleteness in source information as a prerequisite of realising the benefits of telematics.

This section aims to review current practice in the sourcing of public transport travel information, particularly fares and times.

11.2 Sourcing trip planning information

In the context of trip planning, particularly for multi-modal journeys, the planning is only as good as the weakest link in the chain. Transport industries vary in their ability to meet these requirements, with the bus industry lagging behind the other modes.

11.2.1 Rail industry

In the regulatory regime established for the rail industry:

- Railtrack is solely responsible for the initial compilation of train timetabling information for all Train Operating Companies (TOCs) using the rail network. This information is published in the Great Britain Passenger Rail Timetable. It is available, in an agreed electronic format for use by specific information providers through Railtrack’s Common Interface File (CIF). The timetable also defines minimum facilities (e.g. refreshments, Standard Class only) to be provided by the train operators on their services. The arrival/departure times of rail services at all stations are contained within Railtrack’s timetable database and are made available to the public (see Figure 7). The database is updated daily, but some timetable information can change only days before the
day of operation because of engineering work. The rail industry expects to have moved to a rolling 12-week schedule for such alterations by Summer 1998.

- The Ticketing and Settlement Agreement is an agreement to which all train operating companies are party to defining the broad framework of inter-operator arrangements for nationally available ticketing. This includes provision for Rail Settlement Plan Ltd (RSP), a company responsible for managing inter-operator ticketing arrangements, and includes fares setting, distribution of systems standards, allocation of revenue and net settlement of ticket revenue between operators (see Figure 8).

- The Office of the Rail Regulator is a key central body responsible for policing the implementation of the regulations introduced when Train Operating Companies (TOCs) were established. These regulatory changes were introduced to safeguard the rail traveller and ensure the rail system operated as a seamless, integrated whole.

Central co-ordination across the industry of timetabling, fare setting and the effective enforcement of regulations enhances the ability of users to plan journeys. This framework provides a solid and controlled basis for the definition and sharing of statistical data across the industry. This helps to ensure:

- accuracy, through careful information change control processes; and

- comprehensiveness, through making all basic information freely available throughout the industry and onward to customers.

However, in the bus and coach industries (outside London) operators have much greater freedom to define timetables, fares, ticketing arrangements and service standards.

11.2.2 Bus industry outside London

Outside London all bus operators are required to register a service with the appropriate Traffic Commissioner at least 42 days before the service commences/changes. Minor timetable variations (e.g. timetable deviations of up to five minutes) do not have to be notified to the Traffic Commissioner. Service registration involves notification of route (using key geographic features as descriptors) and the service timetable at key points along a route (including the termini). There is no requirement to:

- provide timing information for all boarding/alighting points along a route;

- provide fare information;

- produce timetable information in a specific format or medium (e.g. computer diskette);

- supply timetable/fare information to anybody other than the relevant Traffic Commissioner and Local Authorities;

- use unique names for individual boarding/alighting points;

- amend service information at specific times of the year.

Competition in some areas is such that there is continual re-registering of timetables on particular routes, the rate of change in information undermining the ability of passengers to plan trips.

There is no requirement for coach operators to register their services.

The 42 day period of change notification is claimed, by some local authorities, to be too short for them and other timetable compilers to maintain a publishable database of up-to-date timetable information. Instances of bus operators running unregistered services have also been reported (this practice is reported to be widespread in some areas). Some services have been known to stop operating before the expiry of the 42 day period, often as a result of an operator becoming insolvent.

In addition, while operators have an obligation to copy registrations to local authorities at the same time as they are sent to the traffic commissioner, it is not unusual that they are not copied to the local authorities on time - Local Authorities are the only people to use registration information immediately it is deposited. These difficulties are caused by the absence of:

- any effective enforcement actions which can be taken by local authorities against operators who submit late copies of registrations; and

- a requirement to provide information on any medium other than on paper.

The problem of enforcement has generated a debate about the appropriate registration authority. It has been suggested that Local Authorities, as the main users of the registration information, should be the registration authority. In such circumstances, the traffic commissioners could then have a quasi-judicial role in the event of problems being brought to their attention by operators or local authorities.

Local authorities have powers which enable them to provide financial support to operators who are not prepared to run a service without financial support. In these cases a local authority will tender a service or tranche of services and award the contracts to the lowest bidders that satisfy predefined criteria relating to safety, quality of service etc.

The absence of a central body with responsibility for overseeing the collation and dissemination of bus timetable and fare information for services operating outside London means that comprehensive information is frequently not available. This situation is exacerbated by the large number of operators in the bus industry (compared with 25 TOCs in the rail industry).

The lack of central co-ordination, the lack of effective change control processes and the failure to enforce regulations effectively lead to a general loss of accuracy and comprehensiveness in static bus passenger information. This undermines user confidence in all public transport information sources and represents a significant constraint on users’ ability to plan trips by public transport outside London involving bus. It goes without saying that the planning of multi-modal journeys in such an environment is even more problematical.
Additional Information

- The agreed train schedule has a long lead time of approximately 18 months due to the need of consultation and the provision of equipment.
- The engineering schedule is moving to a programme that will enable train timetable information to be firm at least 12 weeks from the date of travel.
- The TOPS system provides a minute by minute record of what is happening on the rail network from information provided by signals and GPS.
- The TRUST system compares where a train is from TOPS and where it should be from the TSDB to provide information on arrival times and predicted delays and allows performance monitoring by Railtrack.
- The Great Britain Public Rail Timetable is published twice a year. The Train Service Database is constantly updated and service alteration updates are produced in leaflet and poster format weekly. The Train Service Database contains details of all services including freight.
- Railtrack allows access to C.I.F. for information providers so long as Railtrack is acknowledged as the source and the information is faithfully reproduced.

Figure 7 Rail timetable information system
Figure 8 Rail fare information system

Additional Information

- The TOCs (Train Operating Companies) provide fare information to FARES which is operated by Rail Settlement Plan Ltd, public access to these systems is not allowed.
- FACETS, and the more recent systems TRIBUTE and CORSAIR, combines the fare information from FARES and the timetable information from CATE, to give an industry journey enquiry tool.
- CORSAIR is already in use in Cardiff, by Serco Ltd, to provide information to answer telephone enquires for the London area.
- To apportion the revenue generated on a given line between the various operating companies running services on the route, the ORCATS system takes information from the sources as shown above.
- The MOIRA system predicts passenger demand (and hence revenue) changes from planned timetable changes, using the formulae included in the Passenger Demand Forecasting Handbook.
11.2.3 Bus industry in London

Services in London are franchised by London Transport Buses. Before inviting tenders LT Buses will determine the level of service required to satisfy perceived demand or some other demand related criteria. This level of service will then be defined within the tender documents. LT Buses can also require that services are changed on a small number of dates within a year and that bus stop information is provided in a common format. Contracts are let, following a tendering process, for the provision of timetabled bus services using vehicles that meet a quality and technical specification defined by LT Buses.

Service provision is monitored via the Countdown system which monitors the time-keeping of every service operated under franchise. This information source can also be used to dynamically inform waiting bus passengers of the services operating. The ability to know what services are operating at anytime enables LT to operate a comprehensive timetabled information service for London using bus, coach, rail and London Underground services. As a result, accurate multi-modal public transport travel information can be more easily provided for London than anywhere else within the UK.

11.3 Sourcing real-time in-trip information

The provision of valuable real-time in-trip passenger information (e.g. on delays, current location, forthcoming stops and estimated arrival times) requires accurate knowledge of the position of in-service vehicles.

In the air and rail industries there is a requirement for operators to gather information about the position of vehicles for safety reasons. In addition operators can seek compensation from those who cause delays to their services. They are also liable for financial penalties if they cause delays, for example, by blocking a station platform or airport gate due to breakdowns. There are therefore strong contractual management reasons to collect this information. For these modes of transport it is therefore a relatively straightforward task to access information on which to provide good quality passenger information in real-time. This can be disseminated in-vehicle by voice announcement (and in some aircraft through TV monitors), but is mainly provided at interchanges for the benefit of those waiting to join a service or to meet a traveller.

Many taxis use short-wave radio to maintain contact with a central dispatcher which provides the same fleet management functionality, but it is not used to provide passenger information.

A number of coach operators equip their vehicles with technology to enable vehicle location monitoring for improved operational management. Although in transport telematics terms this equipment may be relatively rudimentary (e.g. a cellular telephone used by the driver to report problems and current location), a number are now exploring the scope for investment in more sophisticated automatic vehicle location devices such as GPS/GSM. However, this information is not currently being used to provide real-time passenger information in-vehicle, although it may be used at termini.

The situation is somewhat different in the bus industry, although London is a notable exception.

In London the franchising of bus services has led to a contractual requirement being placed on the franchise holder, by London Transport Buses, to record and provide information about the performance of the service relative to the timetable as a quality measure. This has provided a strong incentive for franchise holders to invest in equipment for monitoring location at all times. This approach by LT Buses has led franchise holders to begin to realise the benefits of improved operational management. It has also enabled them to contribute to the provision of bus passenger information via the Countdown system, for which reason Countdown is generally heralded as one of the most successful examples of bus passenger information implementation in the UK.

Outside London there is generally no contractual responsibility on the bus operator to prove that the registered timetable is adhered to and there are generally no comparable performance quality measures. In principle it ought to be possible for Local Authorities to make the provision of such information a contractual requirement when tendering bus routes, although this could lead to higher tender prices.

In the current regulatory framework in the bus industry:

- there are no safety-related legal requirements for monitoring bus location;
- bus operators are not responsible financially for significant penalties in the event of breakdowns or otherwise causing delays;
- nor are operators able to claim compensation in the event of delays to their services caused by other road users.

Added to this is:

- pragmatism amongst operators about the extent to which they can act on the information gathered to improve service quality, particularly reliability, since reliability is influenced by much wider traffic management issues;
- experience of the shortcomings of telematics equipment during development;
- a comparatively high investment cost (which in the absence of standards could quickly become outdated); and
- a prevalent management culture averse to technologies which could change substantially operational practices in the industry, with all the risks that entails.

Therefore operators see no compelling reason to choose to fit equipment for monitoring in real-time the position of buses on the network, despite possible benefits to transport as a whole.

In trials bus passenger information systems have not demonstrated significant benefits to operators, for example, through consistent and sustained increases in patronage. Investment in equipment purely to provide passenger information is not therefore cost-beneficial in its own right. For this reason it currently seems unlikely that real-time in-trip bus passenger information services will become a market reality in the near future. This is a significant impediment to the provision of good quality information for a significant proportion of public transport users.
12 Barriers to sourcing and dissemination of public transport information

12.1 Perceived importance of information provision
From the perspective of the operator who will have a role to play in improving information sourcing and dissemination, information is just one part of a bigger picture. It cannot be considered in isolation, but as part of a wider package in which it must compete for limited investment funds.

12.2 Lack of co-ordination of information in the bus industry
While bus timetable information and changes outside London must be registered with the local traffic commissioner and copied to the local authority 42 days before the service commences/changes:

- this requirement is not met or subsequently enforced effectively in all areas;
- it only applies to changes of more than 5 minutes;
- information is submitted in a variety of formats (e.g. timetable design, absolute time and frequency) and media (e.g. paper and electronic);
- the traffic commissioner is not required to collate and disseminate this information and, although many local authorities do so, they do not have powers to enforce adherence to the time limit, leading to missing or inaccurate information;
- the information does not have to cover all intervening stops, use common naming conventions or provide fare information.

This undermines the provision of both accurate and comprehensive information about bus services. The situations on bus services in London and on the rail network give some clues about potential solutions. In addition, operators are not normally willing voluntarily to share information with other operators because of the competitive pressures within the industry. This can be overcome by setting up inter-operator arrangements for revenue sharing, but this process is fraught with difficulties.

12.3 Lack of access to comprehensive information
12.3.1 Commercial practices
Operators frequently do not publish the times of other operators’ services. Sometimes this is because of competitive pressures. In the bus industry, at other times, it is because the information is not available to the publishing operator because there is no central body responsible for collecting and disseminating information to those publishing public transport information. Users also believe that corporate branded information is partial (i.e. not comprehensive) even when it is not.

12.3.2 Ensuring understanding
Printed timetables represent a trade-off between comprehensiveness and simplicity to improve understanding. They therefore aim to satisfy most people most of the time. The occasions when they do not offer satisfaction undermine users’ confidence in them as a source of information. Personalised timetables (for which there is strong user demand) can go some way to resolving this difficulty. In addition, electronic systems do not necessarily need to make the same compromises.

12.3.3 Lack of vehicle location information
Knowledge of vehicle location is a fundamental part of being able to provide accurate real-time in-trip information. Such information is not generally available for bus services outside London where there is perceived to be little value to the operator of collecting and using this information, either for operational management or for providing bus passenger information. Experience from London has shown how a change in contractual arrangements under which such services are provided can provide adequate incentives for operators to introduce the necessary technology. Although this is not necessarily the complete, or only solution, it does provide a steer towards a way forward in what is otherwise a difficult area.

12.4 Lack of consistency in presentation
Information is provided to users in a variety of different formats, even within the bus industry. Guidelines have been developed in the bus and rail industries, but these differ and those in the bus industry are rarely adhered to. Information is also current for different periods in different modes and for different operators. The early development of common guidelines across the industries would be valuable to the user, particularly if there were a commitment from the industries to work within such guidelines.

12.5 Complexity of multi-modal network
Many operators are providing disparate networks of services within modes. When these are overlaid in bringing modes together, the level of complexity presented to the user increases rapidly. The situation is much clearer in London and PTEs where public transport services are co-ordinated and planned.

12.6 Need for further technological development
Electronic systems offer distinct advantages over paper-based media for disseminating public transport information. However, they suffer from a number of technical drawbacks:

- electronic systems are not as universally accessible as paper (some require technological skills);
- the information they provide is not currently very portable (i.e. availability in trip is weak);
- many existing expert electronic systems for trip planning information are generally mode-specific and company-specific. They will need to be made more friendly for the untrained user;
- electronic media could easily disenfranchise those unable or unwilling to use new technology.

Further development will be needed to address these weaknesses.
12.7 Inequitable distribution of benefits from investment
The implementation of electronic information systems will entail high initial hardware investment costs and will require investment by operators and/or Local Authorities and PTEs in the computerisation of data (which is only available in varied, often paper, formats in the bus industry). This investment will benefit a variety of stakeholders, not just the body who makes an investment. Some operators in the bus industry may be unable or unwilling to make such investments, but will still benefit from the investments made by their competitors, for example through general increases in patronage, revenue generation, reduced congestion and associated investment by the local authority in improved provision for buses. This means it is unlikely that an operator will agree to pay the full costs of such systems alone. In principle public bodies could take on the responsibility for collating and disseminating such information, charging operators a levy to cover part of the costs, as happens in the rail industry.

12.8 Justifying investment in electronic information dissemination
The internet will make electronic public transport information available to many more people. However, information provision on internet is not currently cost effective as there are no effective mechanisms for charging for the information directly. This does not represent a problem if operators are prepared to offset costs against increases in revenue which may be hard to associate with use by the customer of internet information sources.

12.9 Rate of change in information
For now paper is likely to remain one of the principal means of disseminating public transport information. Yet the rate of change in information, particularly in the bus industry, requires the frequent re-issuing of printed documents. This contributes to the prohibitive cost of distributing timetables to all households, which then leaves users to take the first steps, to hunt out the information. The problem would be best tackled by reducing the rate of change and/or by using dissemination systems capable of keeping pace with this rate of change.

12.10 User acceptability of electronic media
To identify the user’s needs accurately a computer based system will need to ask the user a series of questions. This may be laborious particularly if the user is in a hurry. The alternative is to ask a shorter series of questions and risk delivering inappropriate information. This trade-off is a particular disadvantage of technology. An empathetic member of staff would determine much of this information just by observation (e.g. approximate age, demeanour, visible physical disability). It will be necessary to investigate and define carefully user interface routines.

12.11 Disenfranchising those unable or unwilling to use electronic media
Many users will not be confident with using computer-based expert systems. Others will not have access to the necessary electronic facilities. If such technology is to be used more widely, careful attention will need to be paid to the needs of physically and technologically disadvantaged users. It will be important therefore to provide access through other more familiar means too, for example, Teletext and telephone enquiry services.
Part III: Synthesis and conclusions
13 Synthesis

Earlier parts of this document have summarised a number of barriers to the implementation of public transport telematics and the provision of information based on a detailed review of each subject:

Section 7  Barriers to realising the potential of telematics in public transport

Section 12  Barriers to sourcing and dissemination of public transport information

This section considers the underlying sources of those barriers and aims to identify a basic set of solutions to address the key problems and set a framework for future developments. This process aims to identify initiatives for consideration by Central Government designed to facilitate the improvement of public transport services and information provision through the application of telematics technology.

13.1 Underlying issues

13.1.1 Telematics is not the whole answer

....for Government

A number of examples above have illustrated how telematics applications implemented in isolation from other measures are unlikely to be successful in meeting even basic transport objectives, let alone the more ambitious objectives set by the Government for public transport. To be successful these applications need to form part of a broader range of measures to benefit public transport generally, but particularly in comparison with the car. This means addressing some more fundamental policy issues, including:

- the need to ensure that the wider policy environment supports the development of public transport (e.g. through land-use planning, reducing dependency on the car);
- the need to ensure the commitment of the private sector to delivering integration and modal shift;
- the need to address competition and operational issues in the bus industry.

....for Industry

While public transport operators see information provision for users as necessary, it is but one part of a bigger picture affecting the user’s perception of the quality of service (as illustrated in Figure 9). Improvements in information provision through the implementation of telematics applications must therefore compete with other options for limited investment funding. In addition in the bus industry the operators’ pragmatic view is that significant elements of the formula leading to quality of service performance lie outside their control (e.g. traffic congestion), although arrangements such as quality partnerships can address this to some extent.

13.1.2 Restrictive technology

In moving from research towards implementation, the technology has an image problem. Much industry experience has been based on trials over a limited geographical area using ‘prototype’ technology. Operators and Local Authorities are cautious about investing in this technology until:

- improved reliability is demonstrated (giving confidence that the benefits will be realised before the equipment needs to be replaced);
- national standards/specifications emerge either for systems or for interfaces between systems (especially for vehicle location and bus priority systems to allow the unrestricted operational deployment of equipped vehicles over a wide geographical area).

The portability and accessibility of electronic media for disseminating information will also need to be improved significantly to enable it to supplant paper as the main dissemination route.

Finally, there will need to be continued investment in the development of tools and interfaces for accessing diffuse sources of public transport information on the internet, since it is anticipated that this medium will become of key significance in providing a national framework for the dissemination of trip planning information in the UK.

13.1.3 Competition and deregulation in the bus industry

In 1996 approximately 30% of all public transport passenger distance travelled in the UK was by local bus services and 34% by surface rail. Local bus services therefore have a key role to play in delivering integrated public transport services.

At the same time 79% of all journeys by car (including taxi and van) were less than 10 miles long and 58% were less than 5 miles. Local bus services therefore have a major role to play in delivering modal shift from car to public transport.

Deregulation had been expected to reduce costs and increase efficiency in the bus industry and in so doing lead to improved modal split. This was not the case. The expectation now is that integrating public transport will lead to improved modal split. The problem is that integration is very difficult to achieve in a competitive environment because it is built on contractual and institutional agreement. Thus the current competitive environment in the bus industry caused by deregulation represents a significant impediment to the
delivery of an integrated public transport system and hence the delivery of significant modal shift from the car.

The bus industry is not currently in a position to implement new telematics technology capable of supporting applications to improve the efficiency of the industry in the longer term, the quality of service to the user and the provision of accurate and comprehensive information to users (Figure 10). As the earlier analyses have shown there are many factors which contribute to this position. Some of the more detailed issues are considered below.

In a cost-conscious, competitive environment there are localised examples of cooperation between bus operators (e.g. based on contractual agreements facilitated by Local Authorities), but generally, with the exception perhaps of PTEs, there is a lack of a basic framework of cooperation necessary for building up the size of the market for bus transport and for facilitating through-ticketing.

The statistics in Table 1 show how the bus and coach industry has failed to increase its market size during a period of substantial growth in demand for personal mobility. Indeed the market for travel by bus and coach has reduced in size during this period. This suggests that bus operators are not generally interested in investment in measures designed to increase overall market size, focusing instead on defending market share from other operators. This means it is difficult to convince bus operators of the financial benefits to them of investment in telematics applications whose main effect is to make travel by bus a more attractive option relative to the car (e.g. improving information for users or general service reliability) rather than relative to their competitors (e.g. investment in new buses). Pursuing the implementation by the industry of some telematics applications will therefore mean tackling attitudes which are rooted in the culture of survival in a competitive market.

Local authorities and other stakeholders are interested in securing services which better meet the needs of users, including improved information provision and service reliability. While they recognise that telematics applications can help deliver such improvements, they also have to recognise that for many applications implementation will require the commitment and involvement of industry, including financial involvement. The problem is that local authorities have a relatively limited set of tools available to influence what is a privately-owned industry. Ultimately, however, they have a responsibility to ensure value for money from their investment in public transport services.

In addition to initiatives such as Quality Partnerships, local authorities can, through the normal contractual process, require operators to provide evidence of the reliability and accuracy of service provision. The rationale for doing so is to ensure value for money from their investments in public transport services. A significant element in assessing value for money must necessarily be the quality of service provided to users of the service. Such a requirement, if stipulated, could encourage the implementation of telematics technology such as AVL. Operators will then be in a position where investment in this technology directly affects their ability to compete in

Figure 10 Conditions in the bus industry are a clear impediment to the development of public transport information services which meet user needs
the market. Evidence reviewed earlier in this report suggests that, once installed this technology can also deliver operational benefits for operators and finally can support passenger information systems (Figure 11).

The institutional processes for recording, collating and disseminating service information to users are too inconsistent, unco-ordinated and slow to meet user needs sometimes locally and most times nationwide. Agreed industry guidelines are not adhered to. The system is also too complex for actual and potential users. This is partly due to the rate of change in the industry, but also because of freedoms under deregulation which undermine users’ ability to use the system effectively and with confidence. The main example is the role of the operator in defining (often independently of other operators) the location, name and quality of stops and whether or not their service will call there and at stops established by other operators.

13.1.4 Role of architecture and standards

Separate modes

The separate public transport modes have developed largely in isolation for many years, although there are some examples of joint development and cooperation. Integration will require a higher degree of interaction between modes, particularly from the perspective of the user. Effective integration will require common standards, commitment to implementing them and a framework for cooperation between the relevant stakeholders and for sharing best practice. Common standards, specifications and/or guidelines will need to cover, amongst other things the interoperability of ticketing systems and interfaces between information systems. It will also be important to work to secure the widespread and consistent implementation by the industry of guidelines for the presentation of information to users (e.g. timetables) by paper and electronic media (including user interface protocols). The desirability of developing a systems architecture to support and guide this process will need to be considered carefully given that the essential nature of the task is to bring together a wide range of existing systems which have developed in isolation over many years.

Implementation of public transport telematics

Most of the barriers to implementation of public transport telematics are institutional, not technical. However, the development of the market for telematics applications is hindered by the number of technical solutions being proposed and the rate at which they are changing. Operators and Local Authorities have already found that systems have been superseded after a relatively short life. Given the levels of investment involved, there is a strong need to introduce stability and durability to this product-based market, particularly in the areas of bus location and priority systems and ticketing systems. Further, because these systems are geographically based, there is a pressing need to ensure technological compatibility and

![Figure 11 Possible implementation path for telematics systems to deliver passenger information in the bus industry](image-url)
interoperability between similar systems in adjacent areas. Finally, some bus priority systems interact with urban traffic management and control (UTMC) systems. It will therefore be important to ensure data exchange compatibility between these very different systems in the context of ongoing activities in the area of UTMC system standardisation.

A de facto standard has not emerged from market developments to date. This suggests that at present no one product is perceived as being significantly better than others on the market. The process of agreeing and setting standards would therefore be likely to take some time to achieve. While in progress, it is very likely that interested parties would defer further investments until the outcome became clear. This would at best delay significantly the implementation of these systems and at worst kill the market outright. A faster and less risky approach would be to accept that the major systems in the market represent equally valid technical solutions and to agree standards for the interfaces between these systems, for example by agreeing data transfer formats and communications protocols.

**Provision of information**

Information provision has a key role to play in producing the perception of a common public transport service across all modes (‘seamless journeys’). The process necessarily involves bringing together information processes and standards from different modes, as discussed above. Added to that is the recognition, discussed in great detail earlier in this report, that the information processes and standards within certain modes do not work effectively and do not deliver the information users need. The public transport information supply, processing and dissemination function could therefore benefit from the development and adoption of common quality standards, processes and interface definitions. Alternative basic architectures for the national approach to providing public transport information to users are considered in detail in section 6.2.1 and discussed further in Section 13.3.5 on ‘A national passenger transport information service’.

### 13.2 Solutions and recommendations: general policy framework

The preceding discussions have shown repeatedly how some more general policy issues have impinged upon the effective implementation of telematics for public transport. Since their effect is so important, it is necessary to suggest some possible solutions to strengthen the policy framework within which public transport telematics applications operate.

At the same time it is important to recognise that these are much more wide-ranging transport policy issues for Government. One would not base any significant change in these policies solely on the objective of facilitating the implementation of telematics! But in the context of this report, as a contribution towards the development of the White Paper, it is considered useful to identify the types of changes in the overall policy environment which would help with the implementation of telematics to deliver a significant change in public transport usage/operations and to deliver improvements in public transport information provision.

These underlying policy issues fall into three broad themes:

- Cultivating the wider policy environment to benefit public transport.
- Establishing stakeholder involvement and support.
- Addressing competition and deregulation in the bus industry.

#### 13.2.1 Cultivating the wider policy environment to benefit public transport

The development of telematics services will only flourish within a stable environment for public transport services working within an integrated framework for transport. Public transport faces a difficult challenge to compete effectively with the use of the private car. It will be difficult to deliver modal shift solely by improvements in public transport. It is important to ensure that the broad policy environment affecting patterns of transport demand and delivery support the objective of a modal shift to public transport from the private car. This means, for example:

- extensive reintegration of public transport into land-use planning considerations;
- constraints on the use of the car; and
- ensuring the use of public transport is further encouraged in areas where it is thriving, particularly major urban areas.

In addition, public transport is suffering through lack of investment, particularly in passenger facilities and infrastructure. This has a significant influence on the quality of service to customers and is contributing to public transport’s declining market share. It would be beneficial, therefore, to stimulate investment in public transport vehicles and passenger facilities.

It seems likely that the Government will be pursuing co-ordinated policies to ensure that public transport is seen as a strategic part of the land-use planning process at the national, regional and local level. These might take the form of strengthening PPG13 and PPG6 to emphasise the role of public transport considerations in land-use planning, and amending the provisions of Regional Planning Guidance (RPG) to foster a broader geographical approach to the integration of land-use planning and public transport.

Specific recommendations are:

1. Public Transport in the PTE areas should be supported through policies to improve access to services, improve passenger facilities, enable interchange between modes, provide information to passengers and encourage co-ordinated ticketing. Passenger Transport Executives are well placed to propose and implement such initiatives. They could be supported in this task by making available guidance on good (and bad) practice.

Continued ...
2. Policies should be pursued to balance the benefits of mobility provided by the car with the impact of traffic on the quality of life in urban areas. Policies to discourage the use of the car in congested urban areas should be pursued, while providing public transport with access to city centres. Well-designed Park and Ride schemes should be encouraged where they can offer effective choices to use of the car.

3. Consideration should be given to mechanisms for encouraging investment in vehicles, passenger facilities and infrastructure, including an assessment to ensure that such investments would represent good value for money. Examples of mechanisms which could be explored further might include the introduction of financial incentives for the purchase of new vehicles (e.g., grants or tax breaks), or by adding extra importance to measures proposed by Local Authorities, for example in TPP submissions, which will benefit public transport specifically (e.g., bus priority measures or enhancements to bus stops).

13.2.2 Establishing stakeholder involvement and support
While it is possible to shift the general policy environment in favour of public transport, capitalising on that shift in opportunity to deliver real change will require the stakeholders in public transport to take up the challenge with genuine commitment, co-operation and enthusiasm. There are many signs that the industries have been reluctant to work in this way in the past. It will therefore be necessary to foster an attitude within the public transport industry which is committed to delivering integration and modal shift.

Actions to foster a commitment in the industry to delivering integration and modal shift could encompass a wide range of activities, but in the context of this report this means fostering a genuine interest in improving operations and sustaining or increasing patronage. Both would require working with some segments of the industry to develop a more visionary management culture. For example, many managers remain to be convinced that telematics technology is capable of delivering real improvements in operational management, particularly considering the reliability and cost-effectiveness of such technology. In the bus industry profitability has been driven for many years by success in cost cutting and asset management techniques. Increasing patronage has not been a key tactic in a competitive strategy because, in many ways, success is influenced by factors outside the control of managers in the industry. Indeed, where loyalty to a particular operator is low, taking steps to increase patronage also benefits competitors who may have taken no such steps. Only when managers in the industry accept that increasing patronage is potentially valuable in determining profitability will they focus more intensely on meeting the needs of users. In addition to ensuring good quality and reliability of service provision, such a change would also increase recognition of the importance of information provision for users.

In aiming to foster an increasing level of commitment by the public transport industry to the needs of public transport users, and in aiming to encourage users to place greater confidence in and reliance upon public transport, the Government too may be expected to signal its commitment to seeing the delivery of quality services and information to meet the needs of users.

Specific recommendations are:

4. Government should declare to users and the industry its commitment to working to ensure the delivery of quality services and information to meet the needs of users. This may be achieved by publicising clearly the package of measures it is taking to this end, which might include the implementation of recommendations identified in this report.

The concept of the forum for public transport information is developed further in section 13.3.6.

13.2.3 Changing the bus industry
Some conditions in the bus industry are a clear impediment to the development of integrated transport in the UK and to the provision of public transport information services which meet user needs. To set an appropriate policy and management framework:

5. The Government may wish to review, in the context of the following specific recommendations relating to the deployment of public transport telematics and the improvement of public transport information, the need to amend the current regulatory framework to improve the effective operation of the bus industry in the UK from the perspective of the user.

13.3 Solutions and recommendations: specific areas of development
In addition to these general policy thrusts designed to create an appropriate framework within which change can take place, there are a variety of specific measures which would help to deliver the Government’s objectives for public transport, facilitate the provision of information and realise the benefits of public transport telematics:

13.3.1 Improving static information about bus services
In the preceding parts of this report a recurring theme has been the problems with the quality and timeliness of information provided to Local Authorities by bus operators and the need to ensure improvements in order to be able to support public transport information applications. The report has also explored in some detail the value of the collation and dissemination of this information in electronic format by non-operator organisations (e.g. Local Authorities).

The problems over the naming, location, ownership and quality of bus stops have compounded problems from the perspective of users in some areas more than others. While the earlier sections of this report do not consider possible solutions to this issue specifically, the ‘round table’ meeting of the panel of key stakeholders in the public
transport industry discussed the problems and considered
the merits of a proposal for the implementation of a star
rating system for bus stops and other interchanges in some
detail. In the light of these discussions it is the view of the
authors that such a star rating system is worthy of more
detailed consideration.

Specific recommendations to address these problems are:

6. Government should encourage the establishment of
a forum which aims to raise commitment to meeting
the needs of users for public transport information
across the whole industry. This idea is further
elaborated below. This forum should include
representatives of all the key stakeholders. The
Government should make clear its desire to work
through such a self-regulating, voluntary forum while
making clear its intent to pursue regulation and
possibly even legislation to ensure its objectives are
met should the forum not deliver the required level of
commitment and change.

7. Bus operators should be required as a condition of
service registration, to provide original and updated
service schedule information in a prescribed electronic
format to the traffic commissioner and Local
Authorities. The traffic commissioner and Local
Authorities should be given powers to demand the
timely delivery of such information from bus operators
(i.e. to enforce any such regulation).

8. The traffic commissioners and/or Local Authorities
should be encouraged to take the lead in coordinating
(perhaps through operators, quality partnerships,
contracting out or private sector initiatives) the
collation and dissemination of bus service information
for their geographical area. The information should be
made available in an agreed electronic format to third
parties, including publishers of paper-based timetables.
They should also be encouraged to take the lead in
ensuring that such information is made available via a
freely-accessible, well-maintained internet web site. A
working group comprising traffic commissioners, Local
Authorities and Central Government, in consultation
with user and operator representatives, should consider
the detailed issues associated with ensuring the
collation and dissemination of bus service information,
including enforcement of the timely provision of
accurate information, change control procedures and
whether some of the flexibilities in changing service
schedules should be reduced by regulation (e.g.
discontinue the exemption from registration for service
changes of up to 5 minutes). While proposals for the
resolution of some of these issues may emerge from the
Traffic Area Offices Working Group (which is reviewing
efficiency in the Traffic Area Offices and looking at the
practicalities of electronic registrations), ideally a
group with a wider remit should be looking at the issue.

Continued ....

9. Consideration should be given to encouraging all
Local Authorities and PTEs to take full responsibility
for all bus stops in their geographical area, their
condition, siting and naming. Services should be
grouped at stops depending on destination, not
operator. Bus operators should be required to provide
consistent passenger information for all bus services at
each stop and consideration given to the supply of
power and communications to bus stops where real-
time information may be provided. Despite the extent
to which Local Authorities are already using GIS
platforms for a wide range of tasks, defining bus stop
location accurately is problematical for Local
Authorities for cost reasons. Yet this is key to many
aspects of delivering effective public transport
information services. Consideration should be given to
facilitating cost-effective access to Ordnance Survey
map data for public transport applications.

10. It is recommended that a standard functional
specification for bus location and priority systems should
be developed which defines clearly standard interfaces
with other systems (as a minimum) to facilitate
implementation of inter-operable bus priority and bus
location systems over wide geographical areas as well as
communication with other information systems.

11. The Government should consider further support
for the effective evaluation of projects which aim to
demonstrate or implement telematics technologies
(specifically automatic vehicle location, fleet
management, bus priority and passenger information
Continued ....
First and foremost the purchase of a bus ticket represents a contract between the traveller and the service provider in which the service provider promises to deliver the traveller to a destination. Too often the culture in the minds of both travellers and operators in that a ticket is a permit to be exempt from prosecution for fare-dodging! If the customer is not satisfied with the service, in practice (with the low cost of the ticket) there are few lines of recourse apart from choosing a different service provider - or mode - next time. There is therefore a need to strengthen the contractual link, or at least the perception of it, between the traveller and the service provider.

Unlike individual users, the UK Government invests considerable sums of money each year in bus and coach services. On behalf of all users it is well placed to declare what it believes to be realistic standards or expectations from its expenditure (e.g. service punctuality, reliability and frequency, vehicle cleanliness, vehicle interchange safety and security, information access and quality, standards of management action by service providers in the event of problems, and rights of complaint and recourse). Such standards could be implemented on a contractual basis at a local level by Local Authorities and PTEs during the tendering of contracts for the letting of franchises to provide services over a wider geographical area (thereby affecting the standards on a wider range of services than those procured directly by government).

By requiring the service provider to produce evidence of their performance against the standards, this could lead to the development of a performance-monitoring framework in the bus industry. The same telematics technology can provide information about service performance, improve operational management, support bus priority at signalised junctions and provide real-time information for passengers. Although it is difficult to separate the influence of commercial decisions by operators from the impact of investments made by London Transport, experience in London suggests that operators could well make the necessary investment in telematics equipment when there is a strong business case for doing so. Proof of meeting contract conditions about service delivery appears to be a strong enough reason.

Service performance information would also help in identifying the need for measures to improve service reliability and provide a stronger justification for such investments. This establishes the technological framework for the improvement of operational management, for providing bus priority and for the provision of passenger information. In equipping fleets and implementing management changes in industry to support such processes, it is likely that the benefits would extend beyond services procured under contract by Government and Local Authorities to those procured by other users too.

It seems likely however, that the additional costs will be passed on either directly to the user or to Local Government in tendering its service contracts. It would be very expensive for operators to have to take buses out of service in order to fit them with the necessary equipment. In addition retrofitting is likely to be more expensive than fitting during construction unless adequate mounting points are available. So to reduce the costs of operators as far as possible (and hence the costs passed on to users and Government),

13. It may be necessary to consider how construction and use regulations for buses may need to be modified to accommodate the installation of the necessary in-vehicle equipment in new buses.

13.3.3 Access to real-time in-trip information
Real-time in-trip passenger information is generally available to operators in the rail industry, but rarely in the bus industry. Encouraging bus operators to collect real-time information is addressed in effect through other recommendations. Once this is done in the bus industry, and in the rail industry now, the next step is to encourage operators to disseminate the information to passengers. Passengers require a cost-effective means of receiving simple real-time information relating to their current trip (e.g. expected arrival time, news of incidents and delays, stop location).

14. Consideration should be given to encouraging (possibly via funding jointly with the private sector, projects for research, development and/or demonstration) the development of a basic,
inexpensive personal travel assistant which could be used on board bus and train services or at remote locations (e.g. at home). Such a device might be given to regular rail and bus passengers to provide added value services on public transport. Once established, enhanced devices with greater functionality, in all probability, would be marketed commercially. Such encouragement would be likely to bring such products to market more quickly and could also be used to raise public awareness of such solutions, increasing the rate and extent of market penetration.

These devices are likely to be particularly attractive to people who are currently car users who might be persuaded to use public transport. Encouragement of their development is therefore likely to contribute to the achievement of the Government’s objectives.

13.3.4 Delivering integration
It is anticipated that the process of agreeing common specifications, interfaces and standards across all the modes, which have previously developed largely in isolation, will take some time to complete. An early start will be essential if the process of mutual understanding, cultural change and technical convergence is to deliver early results.

15. It is recommended that the Government should take an early lead in encouraging agreement across transport modes on common specifications, interfaces and standards. Specific areas of standardisation for consideration include, interfaces between information systems, interoperability between ticketing systems and the presentation of information to users.

16. Specific consideration should be given to the harmonisation across modes of guidelines for the presentation of time, service, fare, interchange and booking information for application to all transport modes and in all areas of the country. Such guidelines will need to cover both content and presentation of information. However, similar existing guidelines are rarely implemented effectively. To ensure that this information remains accessible to public transport users, particularly those who are physically disadvantaged, it will be important to work to secure the widespread and consistent implementation of these guidelines within the industry.

13.3.5 A national passenger transport information service
If users are going to be able to plan multi-modal public transport trips from anywhere in the UK to anywhere in the UK, they will need access to good quality information and trip planning systems which provide national coverage. This thinking lies behind the concept of a national passenger transport information service. The issues of access, information quality and trip planning capabilities have been discussed at some length elsewhere in this report, particularly sections 6.2.1, 9 and 10. The key issues to emerge are:

- the need to take steps to improve the quality of information, by meeting user needs more effectively in terms of accuracy, comprehensiveness, distribution medium and location;
- the need to improve the accessibility of this information through supporting systems, e.g. trip planning and enquiry systems;
- the high level of activity in making transport information available on the internet, often following local initiatives.

The proposal for a forum for public transport information is intended to address particularly the first of these issues. The others are effectively addressed here. Section 6.2.1 discussed in some detail the desirability of building on (a) the high level of existing activities in this area and (b) the strengths of distributed processing software and communications protocols established for the internet, through the adoption of a distributed approach to information supply and access. The argument is summarised in Box 1.

An example of many of the problems of operating a centralised passenger transport information systems in a deregulated public transport environment is provided by the experience of Birmingham with the Optimum Route Software (ORS) System. This is described in detail in Appendix B, but the main points of the description are reproduced in Box 2.

So, it is concluded that the objective of developing a public transport information service to facilitate intermodal trips in an integrated transport environment can be realised by the establishment of a framework for a national passenger transport information service. This means setting in place:

- a vision of how the system will be perceived and accessed by users;
- a description of how it will work;
- a framework of standards, agreed protocols and interfaces;
- a software toolbox to deliver information to users.

It is recommended, therefore, that:

17. Consideration should be given to the development of a framework for a national passenger transport information service to facilitate trip planning by users of public transport systems.

The framework should:

- be based on a good understanding of user needs for information;
- provide direct, swift access to information for users, transport staff, the travel trade and other interested parties;
- provide local, regional and national service information, at least, for trip planning purposes which must at least cover timetable information, preferably network (stop/ interchange location) information and ideally fare information (although this is not without its difficulties);
- be a flexible, evolutionary and distributed, rather than centralised, system;
Box 1 A wide range of information systems are available ....

A wide range of information systems are available for supporting trip planning activities. More and more are becoming available in electronic form as web sites on the internet. However, to the user they are fragmented and isolated sources of information. There are two approaches to presenting this information to the user as a single, easy to access source: centralisation or distributed processing. The centralised approach draws the information together into one major source document or database and uses a relatively simple system to retrieve the necessary information. A distributed approach leaves the information in a large number of small sources, but has a more complex system for retrieving the necessary information.

The key weaknesses of the centralised approach are:

- underestimating the tremendous volume of information involved and the difficulty of obtaining it. This leads to incompleteness
- the difficulty and cost of keeping up with changes to all this information. This leads to inaccuracy.

These weaknesses have led to many failures over the past decade or more in attempting to centralise public transport information. While computers have increased in processing capability and memory by many orders of magnitude over the years, the outputs can only reflect the inputs, which are not computerised at source. The inputs therefore reflect the motivations and weaknesses of people, organisations and their management capabilities. These problems are much easier to address in diffuse systems, where people are more likely to feel ownership of a smaller, easier to manage system where it is more straightforward to identify and correct underlying problems.

The distributed approach to information collection has been used for many years. Before the advent of information technology it was a time-consuming, expert activity undertaken mainly by travel agencies and enquiry offices. It has provided swifter access to a broader range of more detailed information. The development of distributed processing, the internet, internet protocols, search engines and other associated software developments is now moving the technology further, towards trip planning search engines roaming internet web sites looking for and collating relevant travel information. The distributed approach also has the advantages over a centralised approach of a higher probability of success, it builds on existing developments, it guides the existing market towards a more integrated future without resorting to regulation, it disaggregates the expenditure over a larger number of players, it can allow the system to be developed incrementally (rather than having to wait for a big bang start) and is effectively available from today.

Box 2 Birmingham - Optimum Route Software (ORS)

The Optimum Route Software system was developed by Lumiplan and ICL with the data provided by British Rail and bus operators. ORS allowed any keyboard operator to enter the origin and destination and the programme identifies the best information on the journey. The system supported a telephone information system (which took up to 6,000 calls per month) and interactive information terminals.

While the system provided the capacity to process the frequent changes to services common to the deregulated environment (in 1993 there were 1600 changes in bus registrations in the West Midlands alone), the ORS trip planner system was taken off line in 1996. The main problem was maintaining an accurate database of timetables. Also, because buses tended not to run on time, connections between modes could not always be guaranteed from the information provided by the system. In addition, the companies that introduced the system underestimated the complexity required. It was estimated that an additional £2m was needed to develop the system fully, yet the total budget was only £1m.

- provide information for (at most) the cost of a local telephone call;
- have a single user interface accessible anywhere in the country;
- be designed and managed (or co-ordinated) at a national level;
- provide for the consistent presentation of information, particularly across modes and geographical regions.

It is recommended that consideration be given to the development of such a framework to facilitate trip planning by users of public transport systems.

In considering how this concept could be implemented, the public access internet is the obvious vehicle of choice for trip planning at home or in the office. However, other options may also need to be considered for other locations (e.g. at interchanges) or to support other services (e.g. travel agency services). These could be based, for example, on direct links to servers holding travel information. Thus, the public access internet is not necessarily the only option available. The internet protocols and software developed for use on the internet are the most valuable component, whatever the vehicle. An impression of how the system might work is shown in Box 3.
Interface with the system. Software systems and the development of the electronic user role in sponsoring the development of expert trip planning information at bus stops. The forum could also play a key role in disseminating the information, for example, printed leaflets. This will also cover other means of presentation, data formats and access protocols for the local transport information service. The Government should: support the further development of the electronic user interface designed to elucidate quickly the user needs.

Box 3 The user logs on to the internet....

The user logs on to the internet, calls up the National Passenger Transport Information (NPTI) page. This accesses a web page maintained on a server by the user’s Local Authority. The page looks the same all over the country. The user enters the journey details (e.g. origin, destination, time of departure), some personal details (e.g. special needs) and travel objectives (e.g. quickest, cheapest). The trip planning search engine which sits behind the NPTI page confers its geographical information system, then roams the internet for web pages holding the relevant timetable, fare and other information. These pages are provided and kept up to date by Local Authorities, PTEs, transport industry businesses and others throughout the country, giving national coverage. The software collects the information, collates it into a user-friendly format and presents it to the user, who prints a copy. Normally the user is delighted with the result and makes a successful multi-modal trip. On this occasion, however, even though (s)he has tried several variations on the search criteria, the user is still doubtful about the advice. The user calls the helpline number displayed at the foot of the page (the number is staffed locally) for further information and advice. When the user makes the journey, similar information is available in a similar format at interchanges in printed and electronic formats.

As a first step to achieving convergence and building on what is already available, the framework for the national passenger transport information service will set a minimum set of standards (e.g. in terms of content, accuracy, updates, presentation, data formats and access protocols) for the local information sources. This will also cover other means of disseminating the information, for example, printed information at bus stops. The forum could also play a key role in sponsoring the development of expert trip planning software systems and the development of the electronic user interface with the system.

With the pace of existing developments in internet information provision and retrieval, it should be possible to make substantial progress in developing a prototype in as little as 2-3 years. This will be much faster than a system based on a centralised national database. For example, in developing a decentralised system for London alone, ROUTES has budget of around £3.5m and to date development work has taken 5 years.

13.3.6 Further thoughts on the forum for public transport information

Section 13.2.2 introduced the concept of a forum which aims to foster a commitment to identifying and meeting the needs of users for public transport information. Its objectives should include:

- continuing the process of defining user needs for public transport information;
- agreeing common standards / guidelines for sourcing and presenting such information (e.g. in timetable form across all modes, in paper and electronic format);
- developing a common, evolutionary user interface for accessing information electronically;
- sharing good practice in sourcing and disseminating information to meet user needs (e.g. through the development and sharing of best practice guidelines);
- ensuring continuing commitment through effective self-regulation.

It is suggested that the forum should be convened by Government in order to signify its role in and commitment to the provision of public transport information to meets user needs.
The forum is intended to develop attitudes across the whole industry. To be successful it will need to include representatives of all the key stakeholders in the respective industries including Local Authorities, PTEs, user groups, operators and the travel trade. In order to ensure continuing commitment to the aims of the group it is suggested that membership of the forum will be a voluntary undertaking subject to agreement to abide by a set of principles described in a Memorandum of Understanding (MOU). The MOU will place on members a set of obligations which might include:

- supporting the activities of the forum (e.g. in cash or kind);
- abiding by the decisions of the forum;
- providing and disseminating information according to standards developed by the forum;
- co-operating with other members in achieving the objectives of the forum.

In order to encourage the active and enthusiastic participation of some elements of the industry it is expected that the forum will need to provide tangible benefits to its members which might include:

- a seat on the forum established for guiding developments in public transport information;
- direct access to key players in Government, service providers and the telematics industry;
- early access to information from other members and from the forum;
- possibly use of appropriate branding (a logo ?) showing their commitment to improving information provision to users;
- encouragement or support for investments which implement the principles of the MOU. This might be achieved by working with local Government in preparing bids for TSG or offering collateral funding.

In working through such a self-regulating, voluntary national forum the Government should make clear its intent to pursue regulation and possibly even legislation to ensure its objectives are met should the required level of commitment and change fail to materialise. An example of a similar body which might offer further ideas for its development and functioning is the Heathrow Area Transport Forum.

To be effective this national forum will need to be supported by commitment and action at the local and possibly regional levels (e.g. by Local Authorities, PTEs, Operators). Specific support would be needed in building and maintaining the components of the system and working to ensure the implementation of agreed guidelines and standards. Whoever takes the lead at a local level, there will be a need to coordinate activities to bring all the relevant parties together to develop the information system for each particular area.

14 Acknowledgements

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## Appendix A: Summary of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ATCO</td>
<td>Association of Transport Co-ordinating Officers</td>
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<tr>
<td>AVI</td>
<td>Automatic Vehicle Identification</td>
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<tr>
<td>(F)AVL</td>
<td>(Fleetwide) Automatic Vehicle Location</td>
</tr>
<tr>
<td>AVM</td>
<td>Automatic Vehicle Monitoring</td>
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<tr>
<td>DETR</td>
<td>Department of the Environment, Transport and the Regions</td>
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<tr>
<td>(D)GPS</td>
<td>(Differential) Global Positioning System</td>
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<tr>
<td>ERDF</td>
<td>European Regional Development Fund</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>FIT</td>
<td>Fixed Information Terminal</td>
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<tr>
<td>GIS</td>
<td>Geographical Information System</td>
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<tr>
<td>GPS</td>
<td>Global Positioning Satellite</td>
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<tr>
<td>GSM</td>
<td>Groupe Speciale Mobile – a European standard for digital cellular radio</td>
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<tr>
<td>IMC</td>
<td>Information Management Centre</td>
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<td>IT</td>
<td>Information Technology</td>
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<tr>
<td>KCC</td>
<td>Kent County Council</td>
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<td>LED</td>
<td>Light Emitting Diode</td>
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<td>LCC</td>
<td>Lanchashire County Council</td>
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<td>LTB</td>
<td>London Transport Buses</td>
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<td>MoBiN</td>
<td>Mobility Information Centre</td>
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<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
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<tr>
<td>MOVA</td>
<td>Proprietary system for controlling traffic flows at isolated signalised junctions</td>
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<td>NEG</td>
<td>National Express Group</td>
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<td>NTS</td>
<td>National Travel Survey</td>
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<tr>
<td>OBU</td>
<td>On Board Unit</td>
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<tr>
<td>PAT</td>
<td>Public Access Terminal</td>
</tr>
<tr>
<td>PAXIS</td>
<td>Name of the Strathclyde passenger information system</td>
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<tr>
<td>POS</td>
<td>Point of sale</td>
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<tr>
<td>P&amp;R</td>
<td>Park and Ride</td>
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<tr>
<td>PSV</td>
<td>Public Service Vehicle</td>
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<tr>
<td>PTE</td>
<td>Passenger Transport Executive</td>
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<tr>
<td>PTIS</td>
<td>Public Transport Information Service</td>
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<td>RNIB</td>
<td>Royal National Institute for the Blind</td>
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<tr>
<td>ROUTES</td>
<td>Rail Omnibus Underground Travel Enquiry System</td>
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<tr>
<td>SCA</td>
<td>Supplementary Credit Approval</td>
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<tr>
<td>SNCF</td>
<td>French-owned ferry and rail operator</td>
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<tr>
<td>SPTE</td>
<td>Strathclyde Public Transport Executive</td>
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<tr>
<td>TOC</td>
<td>Train Operating Company</td>
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<td>TPP</td>
<td>Transport Policies and Planning</td>
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<td>TSDB</td>
<td>Train Service DataBase</td>
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<td>TSG</td>
<td>Transport Supplementary Grant</td>
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<td>UTC</td>
<td>Urban Traffic Control</td>
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<td>UTMC</td>
<td>Urban Traffic Management Control</td>
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<td>VDU</td>
<td>Visual Display Unit</td>
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<td>VMS</td>
<td>Variable Message Sign</td>
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<tr>
<td>WYPTE</td>
<td>West Yorkshire Public Transport Executive</td>
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Appendix B: Examples of non-internet based information systems

London - Information Wholesaler

Description:
Transport operators from a range of modes are joining forces in a project designed to provide the UK’s first comprehensive (multi-modal) on-line travel information service. London Transport, Railtrack, Docklands Light Railway and the Highways Agency have agreed to co-operate in the preliminary stage of the ‘Information Wholesaler’ project, which is to be developed by Smith System Engineering. Other organisations co-operating with the project include the Confederation of Passenger Transport, the Transport Committee for London and London’s Traffic Control Systems Unit.

Costs and impacts:
Not yet implemented

Plans:
The project will explore the possibility of providing the UK’s first source of up to the minute information about timetables, services, routes and current operating status of all networks, initially covering London. The first phase of the project was expected to study the potential for the type of services the ‘wholesaler’ can deliver, how best they can be provided and how the business should be developed. The study was expected to be completed by Autumn 1996, and the feasibility of the project would then be reviewed. There is no further information on the progress of this project yet.

London - ROUTES

Description:
ROUTES (Rail Omnibus Underground Travel Enquiry System) is the London Transport integrated travel enquiry system which will replace more than 2,000 maps and timetables with on screen visual information.

Coverage:
It is intended that the system will provide callers with solutions to complicated travel queries within seconds and will enable customers to plan their journeys more easily as they will be aware of the range of travel options. The system became operational in March 1996. The ROUTES system uses an Oracle database, routing algorithms, a Geographic Information System and Document Image Processing. Data held within ROUTES includes Ordnance Survey OSCAR road centrelime maps, timetable information for all relevant services, geophysical locations for and general information on all bus stops, stations, places of interest etc., details of service providers and ticketing and fare information.

Costs and impacts:
The cost of the project is estimated at £3m. Research undertaken by LT shows that 80% of all enquirers made a public transport journey as a result of the enquiry. Of these 8% would not have travelled and 5% would have used private transport. See Figure B1.

Newcastle upon Tyne - TrueTime

Description:
At the moment NEXUS (Tyne and Wear Passenger Transport Executive) run a telephone information system, but this is paper based and staff have problems with unreliable information (there are over 450 bus services in the area). The system is popular with the general public.

Coverage:
NEXUS are in the process of installing a passenger information central database which will have details of all bus/ train /ferry /metro arrival/departure times. The system is very similar to the ROUTES system introduced by London Transport. The TRUETIME project is being developed by Cap Gemini (a large software house). The database will allow NEXUS to add on modules such as a journey planner. The system will conform to the European standard being developed within the EuroBus project.

Costs and impacts:
The database is being installed at a cost of £300,000 (TRUETIME project).

Barriers to implementation:
The main problem is access to reliable up-to-date information for the 450 bus services in the area.

Plans:
This system should eventually allow information consoles to be placed at major bus/train/metro stations and ferry ports. NEXUS have been involved in the European Project TURTLE which proved that public transport information could be provided on Teletext via local cable companies.

Birmingham - Optimum Route Software (ORS)

Description:
The Optimum Route Software system was developed by Lumiplan and ICL with the data provided by British Rail and bus operators. ORS allowed any keyboard operator to enter the origin and destination and the programme identifies the best information on the journey.

Coverage:
Initially the information was static (covering all modes of public transport) but the system was designed to accommodate warning data about roadworks and to take account of day-specific information. It also provided the
Figure B1 London Travel information trip generation by ROUTES
capacity to process the frequent changes to services common to the deregulated environment (in 1993 there were 1600 changes in bus registrations in the West Midlands alone). The system was used to support a telephone information system and interactive terminals. The interactive terminals were located in each of the travel information centres in the County. Staff provided customers with a printout of information about their planned journey.

**Costs and impacts:**
The interactive terminals cost £20,000 each, but the support for the telephone information system was perceived to be the most beneficial aspect of the system. At its peak it took 60,000 calls a month.

**Barriers to implementation:**
Cost of interactive terminals limited roll-out. By September 1995 five terminals had been introduced. The companies that introduced the system underestimated the complexity needed for such a system. It was estimated that an additional £2m was needed to develop the system fully. The total budget was £1m. Another more technical problem was the definition of an ‘optimum route’. It was found that the perception of the optimum route between two points would vary from one person to the next. One solution was to offer several routes for the same journey, but this solution was not fully developed. The system did, however, prove the reliability of the algorithms used to calculate trip times.

**Plans:**
The ORS trip planner system was taken off line in 1996. The main problem with the system was maintaining an accurate database of timetables in a deregulated environment. Also, because buses tended not to run on time, connections between modes could not always be guaranteed from the information provided by the system.

**Other information:**
Mike Parker formerly Head of Operations (CENTRO) believes ‘we should be aiming for a central bureau as exists in Holland so that telephone link-up can allow anyone to plan an optimum public transport journey between any two points in the country’. ‘But’ he says ‘to do this we would need a national transport strategy and a lot of money’. In the meantime, at local and regional level, he says ‘the key is in the accuracy of the data and that depends in this country on the operators - some are better than others at providing this information. It is to be hoped that upgrading passenger information and the ambience of quality in public transport will motivate even smaller operators to be more responsible.’

**Tyne and Wear - TURTLE Project**

**Description:**
In 1995 the Tyne and Wear Passenger Transport Executive started to develop an impartial public transport information system designed specifically for the needs of older and disabled people through the TURTLE project, and it has been operational since early 1996.

**Coverage:**
The system was initially set up to provide information via Teletext in the Tyneside Cable Area. Through the course of the project the advance of information technology and the increasing availability of the internet, led to the development of an internet site to provide information to users in the rest of the UK. Public access information terminals at bus stops and other locations have been developed within the project. As well as providing timetable information the system also can provide details of facilities at stopping points and details of access to vehicles, stations and vehicles and other locations of interest. The software was developed using the TRANSMODAL data structure, which needed to be modified and expanded to cope with the deregulated environment, but the system can communicate with other TRANSMODAL based systems.

**Barriers to implementation:**
Teletext was chosen as the initial medium for distributing information because of its low cost, wide availability and familiarity to older and disabled people. However in practice it has been found to be relatively slow to use. For access in the home this is not seen to be too much of a problem.

**Norwich**

**Description:**
Norfolk County Council is developing a database of public transport timetables for journey planning, timetable enquiries and bus stop displays.

**Coverage:**
The system is part of the Capital Challenge Project covering the Norwich western corridor quality bus partnership and should be implemented early in 1998 (see Appendix E).

**Nottingham - NETWORK system**

**Description:**
The NETWORK system in Nottinghamshire contains a database of bus and train timetable information.

**Coverage:**
The information is available at about 14 public access points scattered around the County i.e. major bus stations and public libraries.

**Barriers to implementation:**
While the NETWORK system and the NEXTBUS system (the real time passenger information system - see Appendix E) are compatible, the cost of linking the two would require a lot of work and has been estimated to cost in the region of £100,000. There are no current plans to link the two systems.

**Strathclyde - Passenger Information System (PAXIS)**

**Description:**
An electronic passenger information system (known as PAXIS) has been installed in Buchanan Bus Station. This provides reliable, real-time information covering the services
arriving at and departing from the bus station during the next hour. Other information provided will inform passengers whether the service has been delayed or cancelled.

**Coverage:**
This information will be displayed on monitors situated at key locations around the bus station. It will receive scheduled timetable information from the Service Provision Department of SPTE and allow bus station staff to prepare additional timetables for departures and arrivals local to the bus station, make temporary operational amendments to the displayed information, and prepare and display general service information messages.

**West Yorkshire PTE**

**Description:**
WYPTE have introduced 13 to 14 ‘Info Points’ which give travellers information on how best to complete their journey by bus. These access point, located at major bus stations, the airport, Tourist Information Centres etc. rely on a database of static information that can be accessed via a touch sensitive screen.

**West Sussex - SCRIPT**

**Description:**
West Sussex County Council has applied to the European Commission for additional funding to extend the Fourth Framework SCRIPT (System for Community and Rural Integrated Public access Telematics) study and demonstrate the use of telematics in rural transport services. The County, which has recently completed its part in the nine month pan European SCRIPT study, is now keen to develop some of the study’s recommendations. These include ‘demonstrator kiosks’ with commuter terminals allowing the public access to information on public transport services, lift sharing and roadworks.

**Dorset and Gloucestershire County Councils**

**Description:**
County Councils that have large rural areas believe it is very unlikely AVL or electronic journey planning systems will be introduced in these types of area. Although there is great need for real time information on rural bus services (these services are generally infrequent so information about delays or cancellation is important), County Councils could not justify the additional expenditure of these systems, given the current level of funding for rural services.

**Great Western Trains**

**Description:**
Great Western Trains produce a series of paper-based Bus Links booklets.

**Coverage:**
The booklets provide details of bus journeys that can be taken to/from some towns/villages in the company’s operational area in conjunction with a rail journey. Most of the places listed were once served by rail.

**Costs and impacts:**
To date take up has been low but the company plan to continue issuing the guides.

**Barriers to implementation:**
The criteria adopted when deciding whether to publicise details of the bus services include the image of the bus operator. Details of these services are contained within the booklets referenced by ticket-issuing staff.

**Examples from European projects**
The aim of an integrated information system is to have at one point all the necessary information for public and private transport e.g. timetables, fares and traffic information.

Once these regional centres have been set up a national information network can be set up which has to be compatible with other countries. Projects such as INFOTEN which encompasses ten countries are trying to integrate these systems. Once these systems have been set-up, applications such as web sites and public information terminals can access and distribute information from these centres. Information centres are being set-up in Glasgow, Gothenburg, Paris, Munich, Stuttgart, Marseilles and other cities across Europe.

Relevant studies are known to be ongoing in Strathclyde (in the TABASCO project), Paris (in CONCERT) and Marseilles (in ENTERPRICE and CONCERT). It has not been possible to obtain information from these projects within the timescale of this study.

Through the central computerisation of different mode timetables these fixed information terminals, via a multimedia format, will allow users to get information on and plan multimode public transport journeys.

**Bavaria** - 2 interactive information terminals will be installed at motorway service stations in the vicinity of Greater Munich. These terminals will provide information on traffic congestion, real-time road events, weather conditions and the flight schedules of Munich airport (INFOTEN).

**Verona** - 6 FITs (Fixed Information Terminals) will be installed, 4 on the motorway network and 2 at mainline stations. These FITs will provide information on the motorway network and also provide information on train, plane, ship, and regional bus timetables and fares (INFOTEN).

**Piraeus** - Enhanced PATs (Public Access Terminals) positioned at central locations for traveller information. It has not been possible to obtain any results of this work within the timeframe of this review (EUROSCOPE).

**Southampton** - TRIPlanner has been in use since 1995, there are 14 terminals providing information in English, French and German on public/private transport trips either beginning or ending in Southampton or the Isle of Wight. Travellers can get timetable information and the trip planner will give the quickest route by public transport, or a recommended route with approximate journey time for
journeys by car. A similar scheme using 7 terminals has been installed in Winchester and the system is being enhanced to provide real-time information on the state of the network. It has not been possible to obtain any results of this work within the timeframe of this review (EUROSCOPE).

**Genoa** - 2 PATs will be installed at Brignole and Principe rail stations as an initial study, expanding to 10 on-road desks across the city. The desks will provide, in a multi-language format, a ticketing system, real time information on public transport and timetables and information about tourist sites in the city. 2 PATs are also being installed on 2 buses on the route which passes the main tourist venues in the city. It has not been possible to obtain any results of this work within the timeframe of this review (EUROSCOPE).
Appendix C: Examples of internet based information systems

This Appendix describes some examples of Public Transport internet sites. By way of a health warning, internet sites are in a constant state of flux, with sites being added and removed at short notice and their contents changing and evolving. Although current at the time of drafting, some of the following information may therefore be out of date at the time of reading.

Great Britain Bus Timetable (http://www.southernvectis.com)
The latest edition of the Great Britain Bus Timetable has been published by Southern Vectis. The paper version contains 960 pages of local bus information and timetables, details of service changes and a map covering the main bus operators. The web site, which is under development, draws on information from this source and provides details about any service changes which have occurred since publication. Income from the sales of this publication do not cover the cost of publication. The publication’s production is financially supported by some of the major bus operating companies. The company has tested a diskette based system and is currently considering other options.

Austin Analytics (http://www.analytics.co.uk/ptinfo)
Austin Analytics is a public transport consultancy that maintains on the internet an index of reliable sources of UK Public Transport Information. Sources are selected carefully to ensure the reliability objective is met. This internet site includes UK bus, rail, coach, sea and air timetables with information on ticketing, an index of journey planners, local authority enquiry lines, and links to over 200 related sites. Over 7,000 internet accesses per month have been recorded for this site. The service does not generate any income for the consultancy, but is funded for marketing reasons.

Station Master (http://ukbus.u-net.co.uk)
Station Master is an internet site developed by Software Logic for UKBus to provide an on-line journey planner. The site splits journey planning into regions normally by County and allows journey planning by bus rail ferry and walking in these areas. At present 5 Counties use the Station Master journey planner software: Bedfordshire; Cumbria; Hertfordshire; Lancashire; and West Yorkshire. The site also provides links to other journey planners on the internet such as National Express, Railtrack and Buckinghamshire County Council. The site allows destination and start point to be entered either by set default choices or places entered by the user. The day and time of travel can be specified as well as the allowed modes of travel. The software returns 3 journeys which are closest to the specified time and the software can calculate journeys which have up to 5 changes. Town centre maps relevant to the journey can then be displayed. Journey planners for Oxfordshire, Shropshire, Cheshire and Lincolnshire are presently under development.

Buckinghamshire County Council (http://www.pindar.co.uk/bucks)
Buckinghamshire County Council has developed in collaboration with Pindar Routel a comprehensive Public Transport Database system in which information is held on all local services in a form which can be used by a variety of applications. By 1996 this database was being used to prepare roadside information signs, to drive information screens at bus stations, to provide information at free-standing Travel Guide Kiosks and to provide screen based information for operators of the telephone enquiry service. At the end of 1995 to overcome some of the problems with the up-to-dateness of the current information system it was decided to develop an internet site to carry public transport information. By June 1996 the site carried information on public transport in the Milton Keynes area and the site was launched fully in September 1996. Journey planner software was added to the site in June 1997. The Council has commissioned Community Technology to undertake further developments to improve the site through the use of graphical map-based interfaces.

Journey Web
Journey Web is a project set up in the summer of 1997 by Buckinghamshire and Hampshire County Councils in collaboration with Pindar, Pindar Routel, Atkins Wootton Jeffreys and Southampton University with funding from the LINK Inland Surface Transport programme. The ultimate aim of the project is to provide a national journey planning facility, by facilitating the integration of local journey planners with national systems such as those provided by Railtrack and National Express. This service will allow users to enter the relevant journey details at one point and then the Journey Web will gather all the relevant information from the necessary sources, eliminating the need to access various journey planners separately. To do so the project will develop an internet based standard protocol to allow the accessing and passing of relevant information between the various systems.

Railtrack (http://www.railtrack.co.uk)
Interactive train timetables, details of ongoing and planned improvements to stations and lines and limited information on some bus and ferry services.

North West Trains (http://nwt.rail.co.uk)
As well as providing timetable information and journey planning facilities (including routes and fares) the site gives real time information on the state of arrivals and departures at stations in its area, just as would be seen at a station.
Examples (of use of the internet) from European projects
Using information gathered from the Mobility information network MoBiN, a web site giving information on timetables and route planning on public transport for the Greater Stuttgart Area has been set-up (QUARTET+). It has not been possible to obtain, in time, information about the system in South Yorkshire being developed under the TILEMATT project. EUROSPIN is a proposal for a European project to develop and demonstrate seamless public transport travel information services across modes and geographical boundaries. This is expected to lead to intelligent systems, linked by the internet, capable of integrating existing and new public transport information services. The project will make use of distributed and consolidated databases at the regional, national and European scale. Part of the task of the project is to acquire and disseminate real-time public transport information. The project includes Lancashire County Council, Greater Manchester PTE and the City of Rotterdam.
Appendix D: Examples of portable information systems

Personal information systems for physically disadvantaged users

These systems are designed specifically to facilitate the mobility of physically disadvantaged users. They can find particular application in making public transport trips more safe and convenient.

A six month trial of the REACT wayfinder system (developed by GEC Marconi in conjunction with RNIB) has begun at Golders Green tube station. The user carries a small device that triggers speech from a beacon when the user comes in range. It enables the user to locate special parts of the station (e.g. the ticket office, the way out) or to avoid obstacles (e.g. walls, turnstiles) and to inform the traveller about other objects in the environment and the direction to take next. The user carries the device in a pocket or bag, thus leaving their hands free. The system can be used to assist a wide range of people by triggering any electronic device, for example to open a door or call a lift. This could be equally convenient for other people with reduced mobility, such as wheelchair users or parents with pushchairs.

An alternative system is Pathfinder (developed by RNIB and Pathfinder International) which uses infra-red technology rather than radio. Infra-red transmissions require the user to point the device at the receiving beacon as ‘line of sight’ transmissions are needed. When the user comes into range of the beacon the users device transmits a message to the user. Messages are transmitted via the device through an ear piece, so nobody else hears the message. Beacons cost about £350 each and the user device about £150. A trial of the Pathfinder system is currently being undertaken at Hammersmith bus and tube stations.

These systems also illustrate the potential technological solutions for improving the specificity of information provision in-trip, both in terms of location and to meet individual needs.

Examples from European projects

Trials are being carried out in Bavaria with 60 Personnel Travel assistants, 20 of these will be hand held mobile end user devices and the remaining 40 are PC based systems (INFOTEN).

Using the Nokia 9000 communicator as the portable system, another project covers the metropolitan area of Helsinki and a 350km stretch of main highway between Turk and Vaulimaa along which traffic information is available including incident alerts and congestion information. Within the Helsinki area, the user is able to plan trips using local and regional transport, get information on local services via yellow pages. The user is also able to reserve train tickets for services from Helsinki. At present the system is being tested by 20 users with wider trials next year. Similar schemes using the Nokia 9000 are under test in Rotterdam, Gothenburg, Glasgow and Munich. (PROMISE-PTA)
Appendix E: Examples of bus priority and passenger information systems

Birmingham - Public Transport Information System (PTIS)

Description:
The Public Transport Information System (PTIS) is based on a GPS route guidance system that provides real time passenger information at bus stops. Using information received from the satellites, sensors on the buses relay their location to a central control computer. This information is combined with algorithms that include the traffic history of the route to determine the arrival time of the bus at the approaching bus stops. The central control computer is programmed to update the bus stop display at regular intervals as the buses pass through pre-determined locations. The displays generally show arrival time details of the next three buses. Buses relayed their position to the central control computer every 30 seconds with a location plotted with an accuracy of ± 30m. A problem with GPS systems in urban settings is that accuracy, due to reflection from buildings, can be undermined. In Birmingham the required accuracy was ensured by taking the signal from a number of satellites.

Coverage:
The bus stops chosen for real time displays were located on a busy four mile stretch of the A435 Alcester Road corridor (serving approximately 3 million bus passengers a year). Initially 40 vehicles from three operators were fitted with on-board computer units. A total of 5 bus stops were installed with the real time displays (3 inbound and 2 outbound bus stops).

Costs and impacts:
In Birmingham, the cost for the on-board computers are about £1000 per bus while the bus stop displays are about £6000 each. The overall capital cost of the project is £1.2-1.6 million (£650,000 from EU funding under the QUARTET project).

Plans:
To establish what additional benefits AVL systems could offer it is hoped to introduce a more comprehensive scheme in Coventry, where there are bus lanes and shelters at all stops.

Other information:
CENTRO used a GPS system in preference to road side beacon technology because they believe there is evidence to suggest satellite technology will be more reliable than ground based systems.

Blackburn and the Ribble Valley area - Time Travel project

Description:
Lancashire County Council (LCC) have completed the installation of a ground based system that gives real-time passenger information at bus stops. The system, based on Peek Traffic’s Bus Tracker, involved fitting 70 buses with on-board computer units. These units are connected to the bus odometer and radio system. Two types of bus stop display were used:
- 28 LED (Ferrograph) signs (two lines for bus arrival times and one line for other information).
- 12 LCD (GEC Marconi) signs.

On-line computer terminals have been located at the main depots of the principal participating bus operators (Blackburn Borough Transport, Stagecoach Ribble) and at the County Council offices in Preston.

Coverage:
The system operates along a 12 mile corridor between Blackburn and the Ribble Valley. This corridor has two main bus service corridors (Blackburn-Wilpshire-Langho-Whalley, Blackburn-Little Harwood-Sunny Bower). In total there are approximately 22 bus services that run along either all or part of the corridors. These services carry an estimated 3 million passengers a year and are operated by 4 bus companies (Blackburn Borough Transport, Stagecoach Ribble, Cranberry Coachways, Darwen Coach Services). A total of 40 bus stop displays were located at all major bus stops along the corridor. This included 2 in the town centre and 16 in the more rural parts of Ribble Valley.

Costs and impacts:
The County Council funded the project through a Supplementary Credit Approval (SCA) and money from an ERDF grant (Europe). The County Council paid for all the on-board equipment costs which included fitting two way radios (to all buses that operated on the routes), and on-board computers (for the minimum number of buses required to operate the schedule plus a 50% spare allocation). Any buses that needed to be fitted with equipment beyond this figure, will be paid for by the operators. So far no operator has installed additional equipment. This scheme was not introduced as part of a quality partnership between the County Council and the bus operators. The system is currently being tested, but no major problems have been encountered so far.

Barriers to implementation:
Problems with radio transmissions caused by the geography of the area.

Plans:
A future development of the system, being considered, is the integration of the AVL system with the ticket machine. This would mean the processes of the driver logging on/out and fare stage changes would be done automatically. There are no plans to extend the system to other corridors due to cost. Extension of the Blackburn-Ribble Valley has also been ruled out, again because of cost.

Other information:
Improvements along the route also include installing 22 ‘high quality’ bus shelters with lighting, seating and better timetable information. Other bus stops were upgraded where necessary, with the introduction of new kerbs and footways.
Bournemouth - Super Route 17

Description:
Bournemouth District Council and Yellow Buses have introduced a passenger information system, although technically it is not a 'real time' system. The system requires fitting ‘real time’ transponders to buses. Although only 4 buses operate along this route at any one time, approximately 6 buses have tags fitted. As a bus sets off at the start of its trip, a road side beacon identifies the bus (by its unique tag) and starts an internal clock. This internal clock counts down from an historic journey time between the start point and the next bus stop display. The start beacon then communicates this information to the next three bus stops which, using historical journey time data, display the arrival time of the approaching bus. When the bus arrives at the stop the internal clock is reset to the next historic journey time for the current section of road, and the process continues. The system is constantly updating the database of historic journey times between each beacon. This provides a reliable set of journey times between each timing point to base the bus arrival times on. The system is completely open to any operator who installs the appropriate tag onto their buses.

Coverage:
The system has been installed on the branded route Super Route 17. Four buses operate along this route at any one time.

Costs and impacts:
The ‘real time’ transponders cost about £600 each, which the bus company has paid for. The cost of the on-street infrastructure and the 5 passenger displays was paid for by Bournemouth District Council. The system has worked well in Bournemouth, and the bus company has recorded a 5.6% increase in patronage along the route.

Barriers to implementation:
The only problems encountered installing the system have been with locating the displays at the bus stops. The displays had to be positioned on posts near to the bus stops as there were problems fixing them directly to the bus shelters.

Plans:
The system is being expanded to include another route. Super Route 6 will be introduced by May 1998 and will include 16 bus stop displays and 8 vehicles fitted with transponders. Other service improvements will include new low floor buses and an increased service frequency. The route will have the same funding arrangements as Super Route 17 (see Costs).

Other comments:
As the system does not require radio transmissions for communication between the bus stop displays, this is done by cabling, so there was no need for the operator to get a radio licence.

This is a good example of a relatively inexpensive means of providing basic passenger information.

Bristol - ELGAR

Description:
As part of the European Commission’s ELGAR (Environment-Led Guidance And Restraint) research programme, Bristol’s SCOOT traffic control system will be upgraded to give buses priority at junctions, and provide a real time passenger information system at the Brislington Park and Ride bus stop. The AVL system introduced in Bristol is based on GPS technology. The system has been installed by ACIS who took over the original systems developer, Williams Industries (MicroSense are also involved). A similar system has been introduced in Maidstone and Ashford in Kent. The City Council has several on-line computers which can monitor the buses along the corridor.

Coverage:
Phase 1 of this scheme included the introduction of VMS signs on the A4 Bath Road on the approach to the Brislington Park and Ride site. These signs advise drivers of poor air quality, the frequency of local buses and comparative bus and car journey times. It is hoped this information will encourage drivers to use the Park and Ride buses, particularly during periods of severe pollution. Phase 2 will introduce GPS receivers on 6 P&R buses, which will be used initially to give the P&R buses priority at 8 junctions (6 in both directions and 2 in one direction) between the city centre and the P&R site (this should be completed by the end of the year). The GPS system will also be used to calculate the journey time of buses. The journey times of P&R buses along the route will then be compared with the equivalent journey time for cars and the information be displayed on the VMS sign before the P&R site. General traffic journey times will be calculated via SCOOT (at the junctions that have SCOOT) and by historical data for the other sections of the route. This historical information will be stored on a database linked to the system. The next stage of development will be to introduce a passenger information display at a bus stop in the city centre.

Costs and impacts:
The scheme is funded 50:50 between DETR and European funding (DG7/DG13). The on-bus equipment costs in the region of £2k for each bus, while each bus stop display cost around £5k.

Plans:
There are plans to extent real time passenger information to other services along the A4 corridor. This will be funded by the CENTOR project.

Camden bus priority

Description:
SCOOT bus priority system

Coverage:
10 junctions in London Borough of Camden
Costs and impacts:
System installation cost of 200K ecu. This resulted in a 22-33% saving in bus delay per junction giving a 7-8% saving in journey times and having no significant effect on the flow of general traffic. This project has provided economic benefits of 145k ecu per year predominantly through bus passenger time savings and a reduction in operating costs.

Colchester (Essex)
Description:
Essex County Council has introduced a passenger information system in Colchester. The system is not real-time. The system relies on a database of static timetable information, which is used to display the expected arrival time of buses at the main bus station.

Coverage:
The main bus station in Colchester.

Plans:
There are plans to extend this system to bus stops in the town centre.

Other information:
There are no plans to introduce an AVL system for buses in Essex.

Heathrow Airport
Description:
London Heathrow Central Bus and Coach Station is claimed to be the busiest bus and coach hub in the UK. The hub is equipped with a passenger information system driven by a modified flight information system. In addition, BAA Heathrow, in association with the Highways Agency, has designed and built the M4 spur bus lane, the first bus lane on a motorway in the UK. This spur is used by an abnormally high number of PSVs and has a capacity of over 2200 vehicles per hour. Heathrow Airport has also funded the implementation of Countdown (see above) along the route of the A10 bus service.

Coverage:
In and around Heathrow Airport and bus and coach services to the Airport.

Costs and impacts:
The M4 spur bus lane cost £1.3m and was opened in Sept 1997. It has already established its design aims of saving 10 mins journey time during the peak period. One operator (First Bus on the Reading Railair link) has announced its intention of moving from a 30 minute to a 20 minute service frequency because of the improvement in arrival time reliability due to the reduction in traffic variability on this link. An additional £300k was invested in IT infrastructure as part of the M4 spur project to support a telematics-based bus priority system in the near future as a modification to the existing UTMC system.

Plans:
Heathrow Airport plans to implement a telematics-based bus priority system in the near future on the M4 spur, which is built into the existing UTMC system operated by the airport. Work is also underway to offer greater public transport priority via the implementation of a telematics communications infrastructure and development of an AVL system to support, amongst other things, dedicated bus-only airport entrance gates, priority on-terminal forecourts and automatic triggering of bus stand allocation.

Liverpool
Description:
Mersey Travel are piloting a bus priority scheme using AVL at a major junction in Liverpool. The AVL system is already being used for a passenger information system and this trial aims to determine whether the two systems can be linked. The system currently has an accuracy of ±10m, which makes the integration possible.

Liverpool - Timechecker project (Phase I)
Description:
Timechecker is Liverpool’s real time bus passenger information system. This scheme uses the Bus Tracker system installed by Peek Traffic.

Coverage:
The system was introduced on two services to/from Liverpool City Centre. In total 55 bus stops were equipped with passenger information displays and 12 low floor buses were fitted with on-board computers to communicate with the road side beacons and on-bus screens to display next stop information.

Costs and impacts:
The initial demonstration project was funded under the European THERMIE project and Mersey Travel’s Smart project (DRIVE II)). The bus stop displays cost approximately £4000 each. Initial evaluation of the system has produced some interesting findings:

- 5% increase in patronage on routes where Timechecker had been installed
- 68% of passengers use Smart Timechecker consistently
- 90% accuracy rate is claimed
- 85% believe that the use of Timechecker makes waiting more acceptable
- 70% believe the reliability of the bus service has increased since the introduction of Timechecker and 50% believe the provision of Timechecker has reduced waiting times
- 87% feel that Timechecker gives a feeling of reassurance
- 93% believe that real time displays should be added to all Smart bus stops
Plans:
See Phase 2 of this scheme (following).

Liverpool - Timechecker project (Phase 2)

Description:
Mersey Travel have now extended the Timechecker project along the West Derby Road corridor. The poor performance of the Bus Tracker system during the initial demonstration project (see Phase 1 above) required a new system to provide AVL. The ACIS system chosen for this phase, relies on communication with roadside beacons, although the system can be adapted to accepted both ground based and GPS information. The system has the capability of adding a module into the bus driver’s cabin which will warn drivers that they are either running early or late. Both Mersey Travel and the bus company have on-line computers to the system.

Coverage:
Real-time passenger information was introduced along routes 12 and 13 (each with a 5-6 minute headway during the peak periods). Twenty new low floor buses were introduced, each fitted with an on-board computer unit for AVL. A total of 48 bus stop displays were installed along the main corridor where the two services overlap and also in the housing estates at the end of routes 12 and 13. The displays installed in the housing estates suffered badly from vandalism and for these reasons the number of displays installed was limited.

Costs and impacts:
This scheme was jointly funded under the European Objective 1 initiative and a Capital Challenge grant. The scheme was introduced as part of a ‘Quality Partnership’ between the local bus operator and Mersey Travel.

Barriers to implementation:
One of the largest barriers Mersey Travel encountered was obtaining suitable radio channels to operate the system (demand for radio channels is apparently high in North West England).

Plans:
Mersey Travel has funding to introduce real time passenger information to another three corridors. One of these schemes will include 30 low floor buses on a route between the Wirral and Birkenhead and 50 bus stop displays along the route - this will be funded under European JUPITER 2 project.

Other information:
Under the ACIS ‘Routebuilder’ program (runs under Windows NT) it is relatively easy to make changes to the database of timetables and running boards. Mersey Travel have had no problems getting up to date timetable information from bus companies. One of the flaws with the ACIS system is that each morning the bus company must enter the fleet number and running board for each bus into the system, otherwise the system does not know what buses are on the route. This has at times had a detrimental effect on the reliability of the system as the bus company has had difficulty finding the manpower or qualified people to do this essential task. As the system expands this problem will increase. This additional manpower adds to the overall operating costs of the system. The system is being developed so that this task will eventually be automated.

London - Countdown

Description:
Countdown is London’s real-time passenger information system, that uses display screens at major bus stops to inform passengers when the next bus will arrive. Buses are fitted with transponders and all bus stops in the area are equipped with detector beacons. There is no central computing facility so all the bus running information is derived by processors located in displays at bus stops. London Transport Buses intended to offer an open system so that the private bus operators could choose their own AVL technology. However integration tests with other AVL suppliers did not bear fruit so the only realistic decision was for LTB to provide a single supported AVL system to all operators. GPS as well as Radio Triangulation Technology were examined with the general criteria requirement for accuracy of at least ±10m for passenger information, down to ±2m when traffic light pre-emption is required. To ensure that the capturing of information on a central database was kept as simple as possible, LTB came to the view that beacon technology is the best approach.

Coverage:
The system is presently being introduced at 4000 of the busiest bus stops across London. This will involve 6,500 buses (700 routes) fitted with AVL equipment (installed by SLE).

Costs and impacts:
LTB can isolate growth in bus travel in AVL areas and show a positive benefit for bus priority measures, in comparison with control areas in London.

Barriers to implementation:
It will take between 7-10 years to install Countdown in all areas of London. The reason for this long installation time is due to the logistics of preparing bus stops and to accept Countdown. The main hurdles LTB faces are:
- Negotiating with the bus shelter suppliers to install shelters with the necessary cabling and brackets to support a Countdown sign.
- Ensure the local electricity companies can deliver power to the site.
- Ensure BT can provide a data line connection between the shelters.

Plans:
There are plans to introduce a system to manage the distribution of general information messages to bus stop signs. These messages may include traffic disruptions and service diversions. Other developments include:
• Improvements to predicting the arrival time of buses.
• Provision of Countdown information on hand-held devices to be used by LTB’s operating staff at bus stations.
• Providing Countdown on the internet or by touch-tone telephone.

**Other information:**
The costs and benefits of implementing Fleetwide Automatic Vehicle Location (FAVL) on all London buses, were identified as being distinct from passenger information signs at bus stops and any other projects using AVL. The underlying business case is that on-bus AVL equipment captures passing-point times at various locations along a route. This data can be downloaded for analysis by the bus service contractor (i.e. the bus companies) and regulator (i.e. London Transport Buses). In this way AVL can be used as evidence of contracted mileage actually run and at the same time produce the necessary quality of service indicators that the regulator (i.e. LTB) is obliged to make public as part of its Citizens’ Charter. The next tier of investment is in the link between AVL and a radio data transmission capability to provide real-time position of buses displayed on graphics workstations at the bus companies’ premises. This enables the bus operators to manage their services more effectively to so meet the quality targets set by the regulator. With real-time information of all buses held in a central system, the next tier of investment is in the dissemination of this data to the bus stops and the costs associated with commissioning the electronic signs, i.e. Countdown.

**Maidstone - The Kent bus system**

**Description:**
Kent County Council (KCC) has introduced a bus location system (via a GPS) that gives bus priority and passenger information. The system uses Differential Global Positioning Satellite (DGPS) location devices. Each bus is fitted with an on-board computer unit which calculates the bus location, speed and direction at any given time and transmits this information to the control centre. In the urban areas, the system provides buses with priority through junctions controlled by SCOOT 3.1. The on-board computer enables the vehicle to determine its location within ±5m and includes a schedule of virtual loop positions which are the trigger points for the bus to demand priority. At the appropriate point the bus sends this information directly to the UHF receiver at the signalised intersection, and the SCOOT traffic computer revises the signal timings to ensure the bus is not delayed. The system is flexible as the loop positions, journey times, degree of priority are all held within the software, so can be easily changed, for example when a route changes. There is no physical infrastructure of loops, detector and cabling on site which is expensive to install and maintain and vulnerable to damage. Passengers are provided with real-time passenger information at bus stops, which informs waiting passengers when their next bus will arrive.

**Coverage:**
All traffic signals junctions in Maidstone and Ashford have been fitted with UHF receivers such that any equipped bus operating within the area covered by the UTC system can be granted priority. There are currently 32 buses equipped, operating principally in Maidstone. Future buses will be fitted as the system expands to Tunbridge Wells and Sevenoaks during 1998. The Kent Bus System has been operational in Maidstone and Ashford since the beginning of 1997 and the intention is to extend similar priority and information systems to other urban areas of Kent. The scheme is jointly funded by Kent County Council and Maidstone’s largest bus operator the Arriva subsidiary, Invictaway. A public/private funding quality partnership has been set up which reflects the benefits in control and management which this system offers.

**Plans:**
Three areas of expansion are planned:

• Passenger Information Displays: As with priority the bus is able to send approach time information to signs at bus stops directly or via the control centre. This will include digital signs at bus stops and central points to display real-time information to waiting passengers. On bus signs to display the name and travel time to the next stop are proposed with audible indicators to assist the visually impaired.

• Electronic Timetable Database: It will not always be necessary to grant a bus priority at a junction because it may not be running behind schedule. In order that the bus and junction controller are able to determine whether a priority call is required, the system will be linked to an electronic timetable database which provides the scheduled arrival times at all stops. This will ensure that other road users are not delayed unnecessarily as a result of a bus priority call.

• Comparison of journey times: The system has the capability of monitoring bus journey times in real-time and to compare these with the SCOOT journey times measured for general traffic. These comparisons will eventually be displayed on roadside signs to encourage drivers to transfer to buses.

**Other information:**
The interface between London and the surrounding areas is an ideal location to develop the rest of the UTMC concept of compatibility between systems. Kent buses regularly travel into South East London, Woolwich, Eltham, Bexleyheath, Bromley and Orpington and a minimum of 9 routes and 55 buses are effected on a daily basis. Clearly it is undesirable to have separate on-bus units (OBU’s) for the Kent bus system and the LT bus system. The problem is exacerbated if separate OBU’s are also required for the location and priority elements of the system. Interfacing of the Kent and LT systems with a view to development and standardisation of integrated multifunctional OBU’s is therefore highly desirable. Bus operators, especially smaller ones, would benefit through minimised cost of on-bus equipment, and network managers would also benefit through the availability of maximum bus travel information.
Newcastle upon Tyne

**Description:**
Tyne and Wear PTE (NEXUS) introduced a pilot project with real time information displays at bus stops along a busy bus corridor into the city centre. The system was based on Peek Traffic’s Bus Tracker.

**Coverage:**
The scheme was introduced along a busy bus corridor in Newcastle. Nine passenger information displays were introduced along the route.

**Costs and impacts:**
The scheme was introduced within a quality partnership between the local bus company (Go-Ahead) and the PTE. The bus company paid for the onboard computer costs (£650 each). Of the nine passenger information displays introduced, 5 were LED displays at £4500 each and 4 were Liquid Crystal Displays at £2500 each - the liquid crystal displays were housed in something similar to the housing used for the button on pelican crossings, these displays also had a problem with vandalism and needed to be replaced/repaired regularly.

**Plans:**
NEXUS have no plans to extend the current system.

**Other information:**
It was commented that the Bus Tracker system has not worked well. One of the main problems (apart from the accuracy of the displayed information) is that any changes to information on the timetable database is a lengthy and costly process (It is believed Berkshire County Council, for example, incurred about £19000 of cost updating its database). The frequent change to timetable information, common in a deregulated environment, makes this system unappealing to Local Transport Authorities.

Norfolk, Suffolk and Cambridgeshire County Councils

**Description:**
Norfolk, Suffolk and Cambridgeshire County Councils are introducing a real time passenger information system for local trains in the three Counties. Other than the County Councils, participants involved in the project include Railtrack and three local train operators. The system will probably be based on a GPS system, although the County Councils need to satisfy Railtrack that this is the most cost effective solution. Railtrack will take over the running costs of the system in 5 years, so they do not want to inherit a system that is expensive to maintain. The system will continuously track trains as they travel through the network. The location of each train will be transmitted regularly to a central database where the exact arrival time will be calculated and disseminated to ‘information points’ at all approaching stations. The ‘information points’ will have a LCD scrolling screen showing up to the minute arrival times of all trains.

**Coverage:**
If the scheme gets the go-ahead, all trains from the three train operating companies (one of these includes Anglia Railways) will be fitted with GPS receivers and connected to the system.

**Costs and impacts:**
The three Counties involved are jointly funding the project through a Capital Challenge grant. Under the Capital Challenge funding this project must be finished within the next two years.

**Plans:**
It is hoped the real time information from this system could be fed into central database that will hold all train and bus information (see Appendix B).

Norwich

**Description:**
Norfolk County Council introduced a pilot (development) scheme for P&R buses which has includes real time passenger information and selective detection at signal on a road between the city centre and the Airport. The real time passenger information system relays on roadside beacons (installed by Siemens Plessey) while the selective detection at the signalised junctions was achieved through a combination of AVL technology using tags and roadside beacons and transponder/loop technology (at sites were there is no suitable location for roadside beacons).

**Coverage:**
This pilot scheme included 7-8 P&R buses and 4 real time passenger display units (one at the P&R site and 3 others along the route).

**Costs and impacts:**
The cost for the whole scheme, equipment, installation and testing was £2m. It was not necessary to install on-board computer units, reducing the on-bus equipment costs. This was a pilot scheme to determine what could be done by combining the two technologies (AVL and loops detectors). The scheme has been operational for the last 2-3 months so it is too early to tell how successful it has been. Comments from the County Council indicate the system is working well.

Norwich

**Description:**
Norfolk County Council are embarking on a real time passenger information system for buses along Dereham Road (known as the Western Corridor) in Norwich. The AVL system is likely to be GPS rather than ground based for the following reasons:

- The operational reliability of a ground based infrastructure can be badly affected by roadworks and accidents. This means that the system could be out of action for days during repairs to the road or utility infrastructure.
- Repairs to loops and roadside beacons can be both lengthy, disruptive and costly.
- The idea that transponder/loop technology is easy to install with a minimal ‘up and running’ time is not always true. The technology needs a lot of fine tuning before it will work properly. This requires a lot of manpower which can increase the installation costs significantly.
- A GPS system would cope better with changes to the routes of bus services.

It is thought that a GPS based system will be a more cost effective option in the longer term. It must however be stressed that no preferred bidder has yet been chosen to install the system. The radio control system is likely to operate on Band III frequencies. Lower frequency bands have been used in the past but these systems require local booster stations. Obtaining the appropriate Radio Bands has not been difficult, as the demand for frequencies is relatively low in East Anglia.

**Coverage:**
About 30 bus stops along Dereham Road will be fitted with real time passenger information systems. The bus stops at these sites will also have new ‘high quality’ bus shelters. The system will track about 30 buses along the corridor at any one time.

**Costs and impacts:**
The County Council has funded the scheme with a Capital Challenge grant worth about £2 million. The bus company has invested about the same in new buses and the radio control system for each bus. The cost of the on-board bus equipment is around £3000 per bus, while the cost of the signs were about £3000 each. The scheme is being introduced alongside a ‘Quality Partnership’ between Norfolk County Council and Eastern Counties Buses (a First Bus subsidiary).

**Plans:**
Other corridors have been identified as suitable for real time passenger information systems, but this will require funding as the County Council cannot afford the £2.5 million needed to introduce the system along another corridor.

**Other information:**
This is a case of good practice. It has been specified in the contract that the database used to hold the timetable and running board information for the buses must be easy to use, with the minimum manpower needed to update the system. Norfolk County Council have specified that the system must operate in a Windows environment, be compatible with Excel, and require the minimum of expertise to update the system. This should reduce the operating costs of the system to a minimum, and prevent a situation where these costs can escalate out of control. Norfolk County Council require all operating costs to be fully documented in contracts that go out to tender for these systems. The County Council will not pay for any of the development costs before, during or after introduction of the system. If problems occur with the system it is up to the company installing the system to fix the problem. There is a good relationship between Eastern Counties and the County Council. This has meant that difficulties with the scheme have been overcome quickly. The speed of the implementation process has also been helped by a new ‘pro-active’ Eastern Counties Area Manager.

**Nottingham - Nextbus system**

**Description:**
In Nottingham the Nextbus system is a real time passenger information system based on GPS technology. The system, developed by ACIS is similar to that in Maidstone, Kent. The bus communicates between the approaching bus stop signs and the central control. The system has an accuracy of ±150m (this is just about adequate for a passenger information system but not for bus priority), but for an additional cost could be modified to an accuracy of ±10m. At present Nottinghamshire County Council (as with many other County Councils/PTEs that use AVL for passenger information) use electronic tags to give buses priority at lights. The two systems are however completely separate. The system copes with the fact that not all buses are equipped with the on-board computers by referring to a database of timetable and running board information. Any buses that are not identified by the system appear on the bus stop displays at the timetable time. This also happens at times when the system fails or on-board computers are not working. This can at times lead to poor performance.

**Coverage:**
At present the Nextbus system has been introduced on 5 bus corridors in Nottingham:
- Nottingham-Radcliffe-Bingham. This corridor was used to trial the Nextbus real time information system. The original scheme included 40 buses, 5 bus operators and 11 bus stop displays but after the consolidation of bus routes along the corridor this now involves only 3 bus operators.
- Nottingham-Cotgrave. The system introduced 17 bus stop displays along this corridor showing the estimated time of arrival of buses in both graphical and numeric form.
- Nottingham-Clipstone-Ollerton. The system introduced 17 bus stop displays along this corridor.
- Nottingham-Calverton. The system introduced 12 bus stop displays along this corridor.
- Nottingham-Eastwood-Alfreton/Heanor/Ripley. The installation of the infrastructure for this 5th corridor has just been completed. Approximately 17 bus stop displays have been purchased, but have not yet been installed along the route.

The four corridors operational at the moment involve 80 buses fitted with on-board computer units which communicate with the Nextbus system. This amounts to...
about 50% of all buses operating along the corridors. A sixth corridor has also been identified that would justify the cost of implementing this system and this will add another 15 displays. Completion of the sixth corridor will mean a total of 80-90 bus stop displays.

Costs and impacts:
The bus stop displays are approximately £4500 each, while the on-bus computers are about £1500 each. A breakdown of the costs for each corridor is given below:
- Nottingham-Radcliffe-Bingham. Approximate total cost £200,000, financed by Supplementary Credit Approval (SCA).
- Nottingham-Cotgrave. Total cost £130,000.
- Nottingham-Clipstone-Ollerton. Introduced as a Quality Partnership between Nottinghamshire County Council and Stagecoach East Midland, the County Council financed the cost of the system at £170,000.
- Nottingham-Calverton. Introduced as a Quality Partnership between Nottinghamshire County Council and Barton Buses, the County Council financed the cost of the system at £160,000.
- Nottingham-Eastwood-Alfreton/Heanor/Ripley. Introduced as a Quality Partnership between Nottinghamshire County Council and Trent Buses, the County Council financed the cost of the system at £250,000.

On average the base system (for one corridor), which includes two PC computers (one to control the communication system the other as the user interface), a radio transmitter, aerial, software and installation, costs about £100,000. There are also the additional on-board computers and bus stop display costs. There has been no funding for the Nextbus system from the bus companies - all costs have been incurred by the County Council through either SCA or TPP funding. Trent and Barnes (the only operator to have a on-line computer at their depots) use the machines as a management tool (i.e. knowing which buses are where) rather than fine tuning the running times of buses along a particular route. The bus companies generally consider that the expense of employing somebody to monitor buses in a particular Nextbus corridor as unnecessary. Barton Buses and Stagecoach East Midland have both introduced new vehicles on the corridors and both have increased by around 10%. It may that the separate effects of implementing the Nextbus system and improving the quality of the buses operating on these routes cannot be separated to provide a convincing argument to persuade operators to invest in further Nextbus installations. However, the demonstrable increase in patronage should strengthen the hand of the County Council in encouraging operators to contribute to the costs of further installations.

Barriers to implementation:
Nottingham County Council found one of the biggest problems they encountered was to spend the money allocated to them in each financial year. Installing the system along a corridor is a complex logistical task unsuited to a precise annualised accounting requirement. The County Council have now got the installation and testing time for a corridor down to just under a year. Getting consensus within the City Council has also been difficult.

Plans:
In total 15 corridors in Nottinghamshire have been identified as being suitable to warrant the expenditure of introducing the Nextbus system. Ten of these corridors are in Nottingham itself, while the other five are in Greater Nottinghamshire.

Other information:
The system is Windows driven which requires the arrival time of each bus at each bus stop to be entered (i.e. the running board). Nottinghamshire County Council have all their bus timetables on a spreadsheet which means that the data can be copied from the spreadsheet into the database. Although not a difficult task the process can be time consuming and could be improved in the future. One advantage Nottingham has over some other Local Transport Authorities is that bus service routes are fairly well established. The bus companies have established operating areas, which they tend to stick to. This results in a stable bus operating environment, with few erratic and untimely changes to the timetable.

Reading - Route 17
Description:
Berkshire County Council piloted a real time passenger information system along Route 17 (across Reading, east to west). The system is based on Peek Traffic’s Bus Tracker system. The system included 4 bus stop signs. A number of buses were equipped with on-board computer units.

Coverage:
The scheme was introduced along sections of Route 17 which crosses Reading East to West.

Costs and impacts:
Berkshire County Council funded the scheme. Berkshire County Council had funding to expand the system (before abolition) to other routes, however the poor performance of the pilot project (to date) makes further expansion unlikely.

Barriers to implementation:
A general point made was that introducing real time systems along a bus corridor is expensive because all buses that operate along the route must be equipped with the on-board computers for the system to be effective. This may involve equipping a lot of vehicles, as the same buses do not always run along the same route. For example, during the peak period the bus company may operate double deckers along the route while at off-peak times single deckers may be used. This means these systems have high initial costs, but as the system expands the
incremental costs go down. The high initial costs of these systems is a potential barrier against introduction for Local Transport Authorities. Berkshire County Council also had difficulty obtaining radio bands for the system.

It was also commented by a Berkshire County Council official that ‘once you’ve bought into an AVL system it is not easy to get out without incurring a large financial loss’. This occurs because none of the competing systems are compatible. ‘There is no industry standard, so if you buy into a system that then becomes overtaken by a better rival you are left with an outdated/uncompetitive system’. A rather poor analogy is Betamax v VHS. Architecture standards would help ensure competing systems are compatible, giving Local Transport Authorities the confidence to buy into a system, which they could later change (at a minimal cost) if the system did not perform. Berkshire County Council are also concerned that to keep the system up to date they will need to up-grade software and equipment as it becomes available. Committing to unknown future costs is unappealing to Local Transport Authorities. To get funding from the bus operators Local Transport Authorities must be able to convince the bus operators that AVL systems are reliable.

**Plans:**

Berkshire County Council were considering/looking into the possibility of a ‘recorder’ at the terminus of some routes e.g. Park and Ride, before abolition. This recorder would note the time interval between buses and display at what time the last bus left. This would allow the bus driver to leave at a time that would ensure the timetable headway was maintained. There are no plans to introduce AVL to bus priority due to the inaccuracy of the system (±100m). Berkshire County Council did have a system for bus priority at signals, but this relies on buses equipped with unique electronic tags which are recorded by roadside detectors. As a bus passes the beacon the information is sent to the signals to either advance or hold a green signal at the approaching junction. This has been used on the FastTrack P&R buses along the A329M (or A3290 as it is now called) which give bus priority on the approach to the Sutton Seeds roundabout and through Cemetery Junction. This system of tags for bus priority is completely separate to the passenger information system.

**Southampton and Winchester - ROMANSE**

**Description:**

STOPWATCH is a public information system which provides predicted real-time arrival time of approaching buses. It has also been used to provide priority for buses at some junctions. The computers receive low power radio signals from a network of 150 strategically located roadside beacons along two main routes. This data is combined with information obtained from the bus odometer and automatically sent to a central control computer via Band III radio link every 15 seconds. The central control computer then processes the data and using an algorithm, which takes into account historical data for previous journeys along the same route, predicts the time it will take to reach stops downstream of its current position. This information is then relayed to the bus stop displays, by either a radio paging system or via telecommunication land lines. The key to the system is the database, which contains scheduled information relating to bus movements during the day, in accordance with the timetable. This enables schedule deviations to be identified. With the central control computer interfaced to the UTC computer it is possible to automatically request priority at signalised junctions for buses running behind schedule. This active bus priority is processed within SCOOTT.

A trial has been undertaken at four junctions, which indicates the potential benefits for buses receiving priority in this way. The central control software has since been upgraded and it is intended that a large scale trial incorporating a number of junctions across Southampton is to be carried out in 1998. The database for the Winchester STOPWATCH system also contains scheduled information for all services covered by the system. The central control computer has been interfaced to the UTC computer, such that priority for buses running a predetermined length of time behind schedule can be requested. The active bus priority is processed within SCOOTT.

A trial is due to be undertaken at one junction in the near future. It is then intended that further junctions across Winchester are incorporated into the system in 1998.

**Coverage:**

Approximately 180 vehicles from the two main bus operators serving the Southampton area (Southampton City Buses and Solent Blueline Buses) have been equipped with on-board computers for Automatic Vehicle Location. The STOPWATCH system was initially introduced at 43 stops along the Portswood corridor, and then at 20 stops on the Bitterne Road corridor. It is currently being extended further between Southampton and Winchester. There is a second installation of STOPWATCH at 11 bus stops in the City of Winchester.

**Costs and impacts:**

Monitoring of the bus real-time information for passengers found a 5% increase in bus patronage, but this was matched by a similar increase in patronage on the control corridor such that no overall effect could be attributed to the telematics system.

**Plans:**

Winchester - There are currently four vehicles, belonging to the main bus operator in the Winchester area, which have been equipped with on-board computers for AVL. Work is currently underway to equip a further 55 vehicles and this was due for completion in December 1997. A network of 140 beacons will be in place to coincide with the completion of the installation of on-bus equipment for the new vehicles. A total of 20 routes are covered in this way. In addition, the computers on-board nine vehicles will also have the capability to process Automatic Vehicle Location data generated by satellites, using GPS technology.

**Strathclyde - Bus Time Project**

**Description:**

As part of Strathclyde Regional Council’s Integrated Transport Strategy a demonstration project called ‘Bus
Time’ included the introduction of real time passenger information displays at bus stops along the Maryhill Road Corridor. The concept of this system (based upon GEC-Marconi’s Bus Tracker system) is that buses would be fitted with transponder tags which when they passed a receiver, located at a strategic position along the route, would transmit information on the current position of the bus on the route to a central computer. The central computer then transmits a message back to bus stops along the route (taking into account historic journey times at that time of day and prevailing traffic conditions). The message provides the expected arrival time of the bus at the each of the bus stops on the route. This information is then displayed on a screen at each of the bus stops the bus is approaching. The display message indicates the number of minutes that will elapse before the next three buses will arrive (if within 15 minutes). The introduction of the Bus Tracker system generally relies on a radio message transmitted from the bus, however in Strathclyde with so many different operators providing services and with only one operator having a radio system, it was decided that the specification would be different from other areas to allow the expanded city-wide scheme at a future date to be open to all operators whether or not they have a radio. The main features of the scheme are:

- over 600 buses electronically tagged with transponders (£25 each);
- three bus companies, all First Bus subsidiaries, operate services along the corridor;
- 88 tracking beacons sending information to central system over a commercial data radio system;
- a central control system which calculates bus arrival times and sends information back to the bus stop displays;
- PTE owned paging system sends data to the bus stop displays;
- 57 bus stop displays each with three lines, 24 characters per line based on 50 mm high LED’s;
- 10 system terminals with one located in each bus operator’s depot, to allow direct loading of daily fleet allocations and running boards, and at the PTE.

**Coverage:**
The Bus Time project was introduced along the Maryhill Road Corridor (a major arterial route into Glasgow city centre, approximately four miles long). The system involved fitting 600 buses with electronic tags, 88 roadside tracking beacons and 57 bus stop displays. The project has been extended to include an off-street information point in a shopping centre on the Maryhill Road. This visual display unit will enable shoppers to plan bus trips more easily and may benefit the shopping centre by persuading people to stay longer if the bus is not yet due. Another display will follow in a shopping centre in the heart of Glasgow. The VDU allows more flexible images than the conventional LED displays at the 57 stops on the existing corridor. The new sites will give other travel information as well as real time data.

**Costs and impacts:**
This £800,000 project is being funded by Strathclyde Regional Council with assistance from the European Union via the European Regional Development Fund and the European Union’s TABASCO telematics research project.

**Plans:**
Possible future enhancements to the pilot project include introduction of the REACT system (see Appendix D) and the monitoring of long distance coach services using Buchanan Bus Station, thereby providing advance notice of the arrival time at the bus station.

**Proposals for new projects: Leicester**

**Description:**
Leicester City Council will shortly introduce an AVL system for bus priority and real time passenger information. Tendering has just started. A final decision on the type of system to be introduced was due to be made in February. A features document has been produced giving the requirements of the system (there is no preference between GPS or a ground based system but the flexibility of a GPS system has been noted). The AVL system will be used for two applications, bus priority at signals and real time passenger information. The bus priority element of the system will be incorporated within SCOOT 3.1 which has already been introduced on the urban areas of the scheme.

**AVL:**
AVL will be introduced on two routes. The first route is in a urban area within the City boundaries. The second route is in a more suburban area and has links to some of the smaller villages outside the city centre. Each route will have 7/8 real time displays with a total of 40 buses on both routes. The system is being introduced as a ‘Quality Partnership’ between Leicester City Council and two bus operators (First Bus and Arriva). Within this partnership the bus companies will pay for all the on-board equipment costs, while the City Council has invested heavily in bus priority lanes and bus shelters. The bus companies are not exclusively introducing new buses on the routes, although they have bought new buses for other routes. There seems to be a good relationship between the City Council and the Bus Companies.

**Coverage:**
AVL will be introduced on two routes. The first route is in a urban area within the City boundaries. The second route is in a more suburban area and has links to some of the smaller villages outside the city centre. Each route will have 7/8 real time displays with a total of 40 buses on both routes. The system is being introduced as a ‘Quality Partnership’ between Leicester City Council and two bus operators (First Bus and Arriva). Within this partnership the bus companies will pay for all the on-board equipment costs, while the City Council has invested heavily in bus priority lanes and bus shelters. The bus companies are not exclusively introducing new buses on the routes, although they have bought new buses for other routes. There seems to be a good relationship between the City Council and the Bus Companies.

**Costs and impacts:**
Leicester City Council have a budget for the system of about £150,000.

**Proposals for new projects: London - Uxbridge Road**

**Description:**
Trials are planned for next year to test the integration of the Countdown AVL system (roadside beacons not induction loops) with SCOOT v3.1. This would allow the AVL system to be used for both bus priority and passenger information.

**Coverage:**
Uxbridge Road in West London.
Other information:
For more information see ‘Intelligent systems for priority at traffic signals in London: the INCOME project’ by Hounsell, Landles, Bretherton and Gardener.

Examples from European projects

**Turin** - Bus priority was first introduced in 1984 using the UTOPIA system which relied on sensors to detect public transport vehicles, but since 1988 AVM has been introduced and 1350 buses are controlled by AVM which provides the necessary information to enable priorities at traffic lights to be changed. The UTOPIA/SPOT priority system was installed along a 5km tram route at a cost of 0.84MECU. This has given rise to delay savings at junctions of 97% giving a reduction in journey times of 19% with insignificant effects on general traffic. This scheme has been estimated to provide annual benefits of 3.2MECU, 43% due to travel time savings for passengers. The bus fleet of 1350 vehicles are controlled by AVM which is linked to IMC to provide real time information on board and at stops via LED screens. (QUARTET+)

**Toulouse** - The PROYDYN BUS system is being tested over 14 intersections and 2 intersecting bus routes, a total of 20 buses are equipped with GPS units. (QUARTET+)

**London** - The BALANCE Bus priority system is being evaluated along a stretch of the A4 incorporating 6 signalled intersections originally controlled by MOVA. (TABASCO)

**Belfast** - A bus priority system is under evaluation at 2 consecutive 4 way junctions, the system operates in a vehicle actuated mode with a hurry call facility if there is a bus present. (TABASCO)

**Valencia, Spain** - Bus priority at crossings controlled by SAE and STU, the priority is dependent on the state of the lights and the traffic flow. The bus priority scheme is contained within a 12km² area encompassing 6 bus routes. (AUSIAS)

**Strasbourg** - Priority for tramway at intersections is controlled by the individual intersection controller information on tram position gained from sensors on track. Radio links with buses gives SAE the necessary information on bus location, if the bus is behind schedule it is given priority at intersections. On the tramway system real time information is provided at every stop via screens, the information provided gives waiting times for the next two trams which is updated every 30 seconds further information about tickets and special prices is also available. At the 6 combined tram/bus stops, the corresponding information is provided for the buses as well. The waiting times for the tramway are calculated from the speed and position of the tram which is known automatically by the system. For the bus, waiting times are calculated from the number and rate of revolutions of the wheels which is reset at every stop. (EUROSCOPE)

**Genoa** - A vehicle priority system is under evaluation on 5 trolley buses along a section of bus line 20 which passes through 3 sets of traffic lights, the system uses AVM. (EUROSCOPE)

**Glasgow** - Vehicle priority is being evaluated at one three arm junction. Buses passing through this junction are fitted with transponders. A real time passenger information system is being evaluated along a 6.5km route which has 57 information display points at bus stops and there are 383 participating vehicles fitted with transponders to give real time positioning. The display shows the details of the next 2 buses to arrive at the stop and a 3rd line scrolls giving the details of the following 3 buses to arrive. (TABASCO)

**Munich** - Vehicle Priority is being evaluated at one 4-way intersection including a tramway on a separate lane. Passenger information display screens are being evaluated at 3 main bus/tram stations, buses and trams are equipped with AVL which gives travel data. At these stations different display panel techniques are being tested. (TABASCO)

**Gothenburg** - The KomFram system provides the basis for the traffic control system. Using information from the KomFram system and the Traffic Information Centre, real time messages can be generated. These messages are displayed on 26 3-line LED Displays and 10 4-Line LED Displays, situated at bus and tram stops, and at 14 large displays with mechanical elements at bus and tram stops. There are also 4 different types of monitors being evaluated at major terminals, and there are monitors inside a shopping centre giving information on public transport services from the centre. (QUARTET+)
Appendix F: Examples of multi-modal ticketing and integrated payment

Norfolk
Description:
Norfolk County Council has teamed up with Anglia Railways and Eastern Counties Buses to launch a multimodal ticketing initiative. The scheme will provide free bus travel to rail season ticket holders from Norwich to any destination within the Eastern Counties Centrider area, and on two buses to and from Great Yarmouth station.

West Midlands
Description:
Public Transport passengers in the West Midlands may benefit from integrated bus and rail ticketing and timetabling under an initiative from the National Express Group. NEG own the main bus company Travel West Midlands, as well as the Central Trains franchise, but is also hoping to involve other bus and train operators in the scheme. It plans to phase in the ‘seamless ticketing’ scheme over the next few months. The first phase is likely to involve the addition of a supplementary fare to rail ticket prices for travellers arriving at main West Midland stations which would enable them to travel onwards by bus.

Heathrow Airport
Description:
The Heathrow Area Travel Card was introduced in July 1997 aimed at the travel needs of the 56,000 airport employees. The card is accepted for travel by 9 different operators over 17 different routes and is currently being extended to other services, offering destinations as far afield as Oxford, Ipswich and Norwich. The system is currently paper-based, but the operators are looking at a smartcard application. Steps are also being taken to try to extend the system to incorporate rail operators.

Oxford and Brighton
Description:
In Oxford it is possible to buy a travelcard allowing local bus travel in Oxford, rail travel to London and unlimited use of the underground and bus networks in central London. If the journey ends in a town where a similar scheme operates, for example Brighton, the same ticket includes bus travel at the destination. This integration has come about from Go-Ahead’s Thames Trains and Thameslink rail franchises and Go-Ahead’s bus operations in Oxford and Brighton. Brighton and Hove buses (Go-Ahead) have introduced a similar scheme in conjunction with Connex South Central and Thameslink.

Other schemes
Further bus-rail integration is being developed in areas such as Luton, where new bus links between Luton and Dunstable, provided by Arriva, will be more closely integrated with Go-Ahead’s Thameslink services, including through-ticketing. Similarly in High Wycombe, local Go-Ahead and Arriva bus operations are integrated with Chiltern Railways’ services.

Examples from European projects: Integrated payment systems
The development of an integrated payment system for public transport and other services using multi-function smartcards aims to encourage users to switch to public transport by eliminating the problem of ‘exact fare’ systems and the need to carry cash. Development in this field has been slow due to the inherent transaction time of contact cards which is too slow for public transport use. However there have been recent developments in the latest generation of smartcards which allow contactless transactions with the security of transaction required by operators.

Within the CONCERT project there are known to be trials in progress in Dublin, Bologna, Thessaloniki, Barcelona and on the maritime link between Greece and Italy. Further information could not be obtained in the timeframe of this study.

Gothenburg - Since April 1997 trials for automatic toll and car parking fee collection using a smartcard connected to a vehicle mounted transponder, have been under test with 50 users. One toll barrier and one car park are participating in the initial study. The smartcard also has a magnetic stripe so that it can be used in regular card readers and petrol pumps. Other functions this card can be used for, are a transport purse, a travel log file and a public transportation pass (ADEPT11).

Rome - A multifunction smartcard is being developed for road pricing, park and ride and PT fare payment. An integrated fare system for bus, metro and urban train has been in place for several years. The existing interactive kiosk network (250 ticketing machines and 90 info + ticketing terminals) is being incorporated into the scheme (CAPITALS).

Valenciennes - Under the Transcarte project, in autumn 97, Valenciennes in Northern France will be the first city to implement a multimodal hybrid smart card allowing contactless and contacted transactions. The card can be used for paying for public transport and parking. In the scheme equipment will be installed on 280 buses, on regional trains at 20 stations, 11 depots and 125 retail outlets. Due to its compatibility with all SNCF ticket vending machines and point of sales equipment, the system can be easily implemented in other cities in France.

Examples from European projects: Integrated payment by Smartcard
In Dublin the GAUDI field trials were carried out for one month on the use of a multiservice electronic purse. Over 10000 transactions were carried out by 1000 users. Users were able to use the card on one bus route, at 20
payphones, 1 car park, 1 toll bridge and 4 POS terminals. It was found that 46% of the cards were used to pay for more than one service and 135 for more than two.

Questionnaires showed that 91% of respondents found the electronic purse a convenient way to pay for services.

In Marseilles over a five month period with 1000 users trials were carried out on an electronic purse, over this period more than 55000 transactions were carried out through 66 televalidators. 25 of these were at metro stations, 16 on buses, 15 at interurban bus/rail links, 2 at P&R, 2 at a tunnel and 6 POS sites. It was found that 46% of cards were used to pay for more than one service and 21% for more than two. 84% of users highly regarded the electronic purse as an alternative to cash and ticketing systems.

From these two studies it seems that smart cards are more reliable than magnetic swipe cards.

In Finland smart card based public transport fare collection systems have been implemented since 1988, at present 20 fare payment systems and three city card systems are in use. The Finnish Government has taken an active role in supporting the development of smart cards since its decision in 1990 to focus on smartcards as a means of public transport payment. A contact smart card was chosen, as the standardisation for these cards was more complete, allowing the card to have electronic purse applications as well.

The three citycards not only allow the payment of public transport services but also allow for other city services to be paid for such as parking and leisure activities. In the city of Tampere the smartcard scheme was introduced in 1995 and at present there are 52000 cards in use, with approximately 50% of public transport journeys being paid by smartcards. In 1996 a smartcard payment system was introduced in the city of Turku, there are approximately 20000 cards in use making approximately 40000 payments/day and account for 24% of the public transport revenue. A citycard scheme will be introduced in Helsinki and the surrounding metropolitan area early in 1998.

From some initial trials in Berkshire it has been predicted that there could be financial benefits for operators running smartcard schemes, from the revenue generated from cash floats and pre-paid revenue, which could amount to 3-9% of total revenue generated by the scheme. A study in the USA states that after the introduction of an electronic fare system there was an increase in passenger patronage of 2 - 5%. By the year 2000 it is expected that transport smart cards will account for 5% of the total smartcard market and a 1/3 of these being used in Europe. Results from the Pay card trials in Stuttgart show that after the introduction of smartcard payments overall system operating costs fell by 2-3%.
Abstract

In the first part of the report the market for public transport services in the UK is reviewed as a prelude to the discussion of policy objectives for the integration of public transport and delivering modal shift. The report looks in particular at information systems for trip planning, portable information systems, operational management aids, bus priority systems, real-time passenger information and multi-modal ticketing and integrated payment systems. A wide selection of UK and European trials of these applications are reviewed. The second part of the report looks more specifically at the provision of information to meet user needs in the UK, considering the information needs of passengers in the context of types of information, location, user groups, types of journey and mode of transport. The report also considers current practice in the sourcing and dissemination of information to users. In a concluding synthesis of the earlier sections a series of far-reaching recommendations are presented which aim to address effectively the issues raised.

Related publications

TRL330 Information for bus passengers: a study of needs and priorities by R Balcombe and C Vance. 1998 (price 30, code H)
TRL220 Review of the potential benefits of road transport telematics by K E Perrett and A Stevens with contributions by J J Wilkinson and P F Masurel. Editorial support: J M Hopkin. 1996 (Volume 1 main report price £60, code Q), (Volume 2 technical annexe price £100, code Y)
TRL255 Bus priority in SCOOT by G T Bowen. 1997 (price £20, code E)

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