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An ITS Vision for Melbourne's Southbank Precinct

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Abstract:

Melbourne’s Southbank area is achieving prominence as an activity centre because of the variety of cultural, sporting and entertainment opportunities which it provides. This paper outlines opportunities to maximise the economic and social value of the area by facilitating travel to andthrough the area. The focus here concerns the integration of *intelligent transport systems* (ITS) into the Southbank area. ITS covers the application of advanced information processing and communications, sensing and control technologies to surface transport. ITS will assist in the reduction of traffic congestion and inconvenience to drivers, public transport users, pedestrians, bicyclists and other travellers. The level of technology that is presently available revolves around variable message roadside signs, radio broadcasts and telephone services. For motorised vehicles, roadside systems appear to present the best option for parking and traffic information. Radio and television systems have the advantage of reaching an urban-wide audience while the roadside systems can focus on particular areas. The linear nature of the Southbank area and associated transport infrastructure lends itself to roadside information providing directions to parking and other facilities. Information for pedestrians can be provided in localised information booths or kiosks. This information could relate to entertainment, places of interest, public transport timetables, provisions of taxi services and parking. The Southbank area stands to benefit not only in the long term, but also during the period when much of the area is being developed, from investment in an ITS to cater for the diverse needs of the many people will visit Melbourne’s entertainment, sporting and cultural hub.

Keywords: intelligent transport systems, integration of Southbank with CBD, utilisation of Yarra River, advanced information processing and communications, extensive Southbank development, future traffic volumes, light rail/tram, road-based systems, public transport vehicles, traffic conditions, parking, advertising, in-vehicle computers.

1. INTRODUCTION

Melbourne's Southbank area lies adjacent to the southern edge of the CAD (Figure 1). It is emerging as Melbourne's premier entertainment, sporting and cultural precinct and covers nine venues for major events: Melbourne Cricket Ground, National Tennis Centre, Olympic Park, Melbourne Sports & Entertainment Centre, Botanic and other Gardens, Victorian Arts Centre, Crown Casino, World Congress Centre and Exhibition Centre. As highlighted by Figure 1, the area is adjacent to the $2B City Link freeway project.

The work reported here was undertaken as part of the Southbank Area Integrated Transportation Study. A Working Party, Chaired by the Victorian Department of Transport, commissioned the study to develop options for the Southbank Area Transportation Management Plan. The need for the plan was identified by various state and local government bodies due to the significant redevelopment of Southbank as Melbourne's premier entertainment, sporting and cultural precinct (with transport initiatives associated with individual projects), impending construction of City Link and current high level of road congestion for extended periods of any day. The area is adjacent to Flinders St Station, hub of Melbourne’s metropolitan rail network, but the majority of transport in the Southbank area is road-based: cars, freight, public transport (buses, taxis and trams), bicycles and pedestrians. Many transport studies have previously been commissioned by a range of the area's stakeholders however no investigation assessing the transport requirements for the overall redevelopment and all modes had been undertaken. The Southbank Area Integrated Transportation Study involved road transport planning for a broad range of (road-based) modes for the entire Southbank Area. The primary objective of the study was to *develop options for a Transport Management Plan for the Southbank Area for the period prior to the opening of City Link.* This was broadened out to achieve improvements in:

- levels of service for access, internal movement and through movement;
- livability/urban design;
- integration of Southbank with the CBD (and Docklands);
- utilisation of the Yarra River;
- utilisation of existing transport infrastructure.

To maximise the economic and social value of the area the facilitation of travel to and through the area is a primary concern. A major component of the planning of the Southbank area concerns the development of physical infrastructure such as buildings, roads, public transport links, etc. This paper highlights the complimentary role that advanced technology, in the form of communications infrastructure and information processing can play in ensuring that the potential of the area is achieved. While the study had a roads emphasis, this paper takes a multimodal perspective when considering the integration of ‘intelligent transport systems’ (ITS) into the Southbank area. ITS covers the application of advanced information processing and communications, sensing and control technologies to surface transport. In broad terms, the objectives of ITS are to promote more efficient use of existing transport networks, increase, safety, enhance mobility and decrease environmental costs of travel. ITS presents opportunities to maximise the return from investment in the transport system and will produce benefits for drivers, public transport passengers, bicyclists and other travellers.

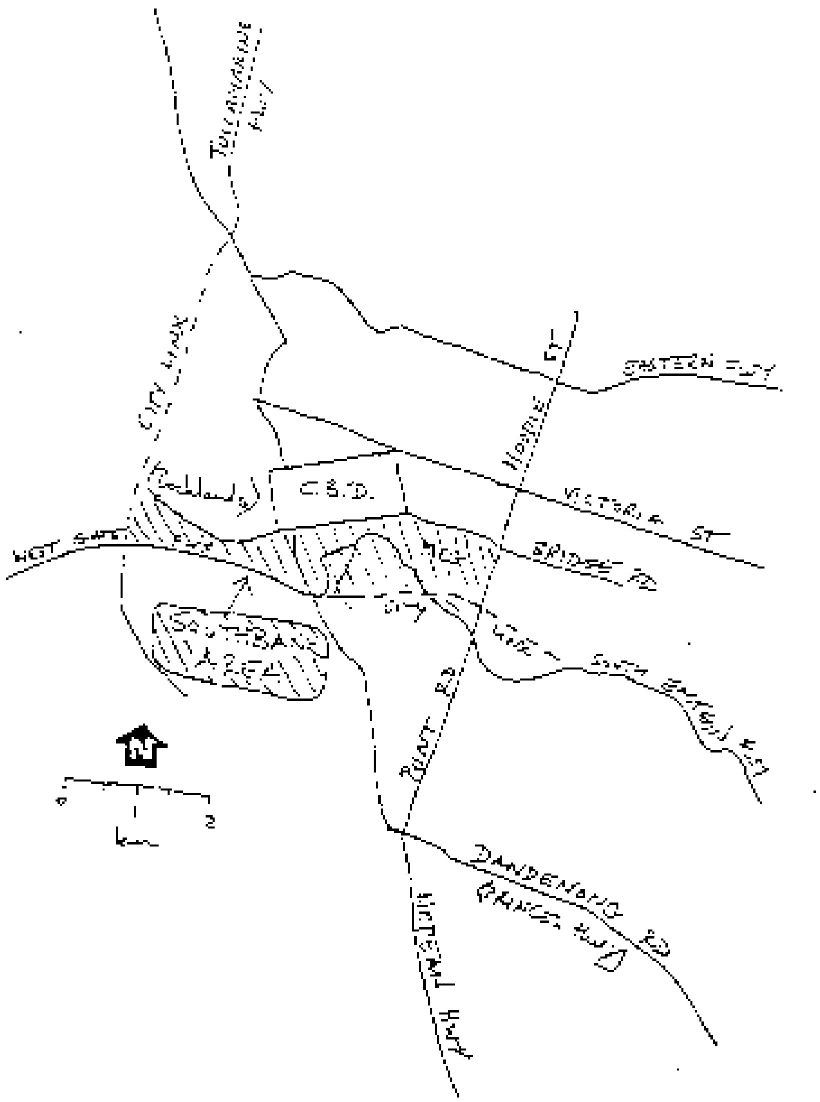

Figure 1 Locality Plan

The structure of this paper is as follows. It begins with a review of the Southbank area highlighting current transport issues and pending infrastructure enhancement (Section 2). The scope and role of intelligent transport systems for the Southbank area are then considered (Section 3) including a review of the ITS components which could see application in the Southbank area. In Section 4 an ITS vision is described for the Southbank area. Consistent with ITS throughout the world this section highlights the scope for a partnership between the public and private sector in establishing ITS in the Southbank area. Finally, the conclusions of the paper are presented in Section 5.

2. SOUTHBANK TRANSPORT TASK AND ISSUES

This section places the existing travel demand and transport services into perspective.

Demand Issues

As noted earlier there are nine venues for major events in Southbank. These venues have a combined capacity of 300 000 patrons. With around 720 events annually, equivalent to over 14 major events each week, the peak crowd on a Friday and Saturday night reaches 200 000. Surveys of events over many years have continually indicated a car driver mode split of 17%, giving around 35 000 vehicles in the Southbank Area associated with major events alone. The peak hour generations are:

- 5:00 - 6:00 pm (road network peak): traffic: 20 000 vph and 40 000 passengers
- 10:00 - 11:00 pm (major event generation peak): 35 000 vph and 80 000 pax/hr

Extensive redevelopment is occurring in Southbank, complimenting the existing sporting and entertainment facilities. Within 5 years the area will contain:

- apartments: almost 3 000
- hotels: almost 2 000 rooms
- office: over 250 000 m² GLFA
- showrooms: almost 90 000 m² GLFA
- theatres: almost 30 000 seats
- sports grounds: approx 150 000 seats
- public open space: over 300 000 m²
- institutions: Coroner's Court, Children's Court, Victoria Barracks, ABC Radio, TAFE College, Victorian College of the Arts, Australia Post Mail Centre
- other developments: Crown Casino, Exhibition Centre, World Congress Centre, Southgate, National Gallery, Federation Square (international tourist centre), Botanic Gardens Conference Centre, HSV 7 TV studios and Flinders St Station.

Various localised roadworks are being implemented as part of the redevelopment, however the major transport infrastructure is City Link, to be open for traffic in the year 2000. This will be a freeway in tunnel and on elevated structure running through Southbank connecting the West Gate, South Eastern and Tullamarine Freeways, as indicated in Figure 1.

The Existing Transport System

Melbourne has a radial metropolitan transport system originally planned to service the city's CAD and comprising roads, heavy rail, generally on-road light rail (trams) and on-road bus services. The Southbank Area is immediately adjacent to the CAD and was an industrial area when the inner metropolitan transport infrastructure was provided, resulting in a concentration of arterial through routes in the area (eg Jolimont rail yards, St Kilda Rd tram group and Kingsway, Batman Ave, Alexandra Ave, City Rd, West

Gate Fwy and Punt Rd). This transport system services commuter travel to the CBD, cross-town through trips and access to the leisure-related developments and events in Southbank.

The Southbank Area is also one of the most important freight movement corridors in Melbourne. Access from the south-east of the metropolitan area (centre of population and manufacturing) to the ports, airport, railway terminal and National Highways to Adelaide, Brisbane, Canberra, Sydney and Geelong passes through Southbank. Providing the City Link freeway standard bypass of the CAD is critical to efficient freight movement.

The heavy rail network bypasses the Southbank Area and the Yarra River, which lies between the CAD and Southbank, is not currently used as a major transport corridor. This results in an essentially road-based multi-modal transport system in Southbank: cars, trucks, trams, buses, taxis, bicycles and pedestrians.

The typical existing weekday pm peak hour (5:00 - 6:00) volume of road traffic in the Southbank Area is in the order of 30 000 vph. Of this approximately 25 % (8000 vph) are locally generated compared to 75 % (22 000 vph) of through trips. The remaining 2 % are internal trips. The major through traffic movements are 20% north-south (6 000 vph) and 20% east-west (6 000 vph). VicRoads estimates that 23% of the through traffic will use City Link in 2001.

Estimates of future traffic volumes, based on proposed development, for 1996 and 2001 are 33 000 vph and 37 000 vph respectively for the pm peak hour. This corresponds to a 23% traffic growth by 2001 (3.5 % pa. average), made up of 50% growth in local traffic (8 000 vph increasing to 12 000 vph) and 14% growth in through traffic (2.2% pa.).

Heavy rail has 14 lines with services operating between 4:00 am and 12:00 midnight 7 days a week. Headways through Flinders St Station (all services) are between one and four minutes. A link across Yarra River between Flinders St Station and Southgate is provided by the `Running Lady' pedestrian bridge, as indicated in Figure 2. Jolimont Station (7 lines) is about 10 mins walk from MCG, National Tennis Centre, Sports and Entertainment Centre and Olympic Park. Flinders St and Jolimont Stations offer substantial transport capacity for Southbank but there is currently only limited pedestrian access between them and specific locations. Preliminary consideration has been given to the feasibility of a new rail station dedicated to serving the Melbourne Cricket Ground.

The light rail/tram (on-road) service consists of 16 routes passing through Southbank. These operate from 5:30 am to 12:00 midnight Monday to Saturday and from 7:00 am to 11:00 pm on Sunday. Headways are typically 5 - 10 minutes during the peaks and stretch to 20 minutes in the evening and at weekends. St Kilda Rd is common to 8 routes which give headways (across all services) of 1 minute in the peak and 2 minutes

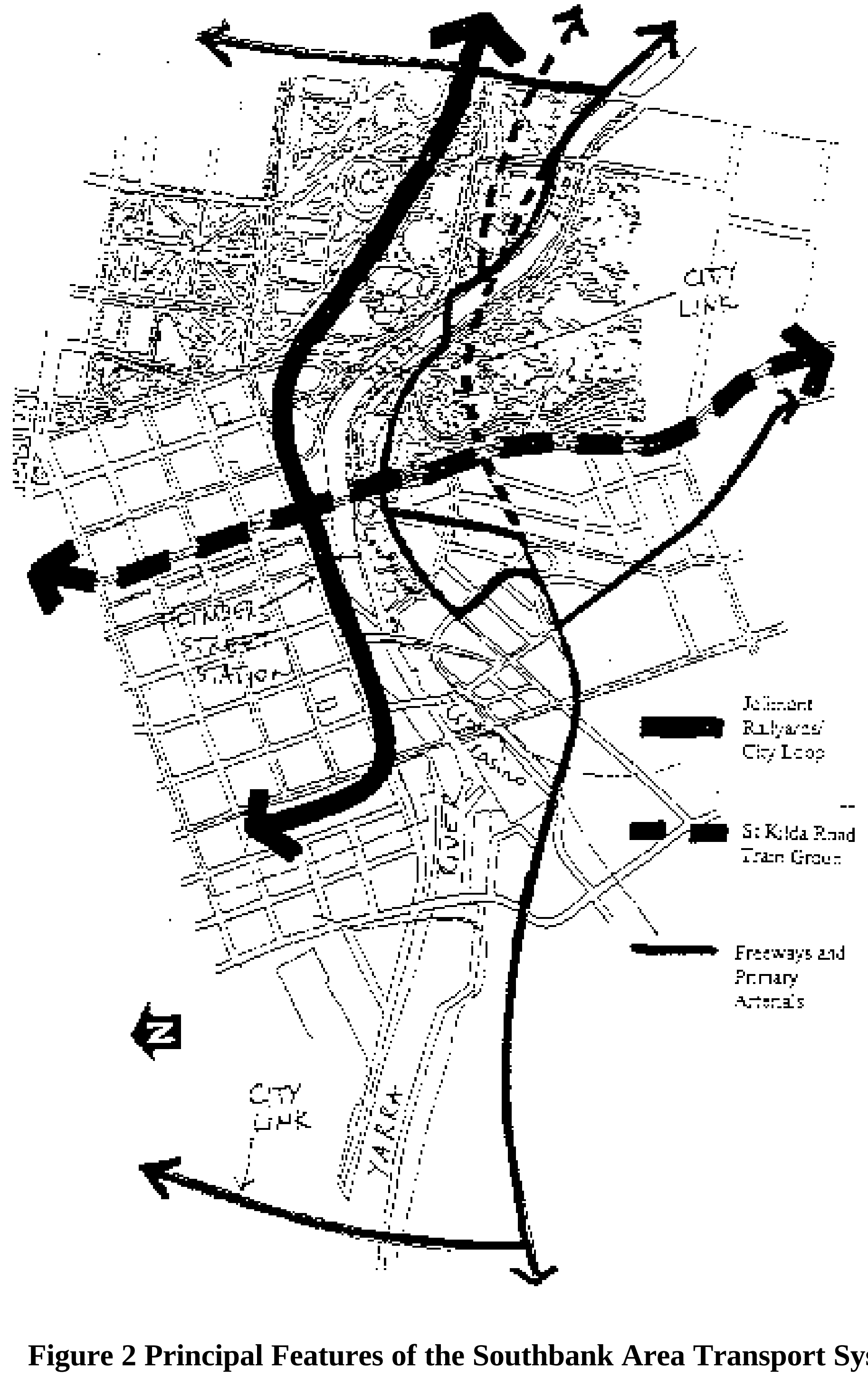

Figure 2 Principal Features of the Southbank Area Transport System

interpeak. The routes have been planned to service the CBD commuter demand and therefore provide substantial capacity during weekday interpeak and evening and weekend periods but only along specific corridors within Southbank.

There are 9 bus services passing through Southbank operating between 5:00 am to 12:00 midnight Monday to Saturday and 8:00 am to 12:00 midnight on Sunday. Headways vary between 7 minutes in the peak to 30 or more minutes in the evenings and at weekends. The routes cross Southbank in a north-south orientation in the western part of the area, complimenting the tram services which predominantly run in the eastern section. Overall buses currently offer only a limited transport system in Southbank. In addition there are 9 NightRider bus services operating on Saturday and Sunday between 12:00 midnight and 6:00 am at one hour headways, with one service also operating 12:00 midnight to 6:00 am Monday to Friday. NightRider buses depart from the CBD near Flinders St Station.

Only one taxi rank is provided in the Southbank Area, located outside Flinders St Station.

Existing Levels of Service

The road network operates at capacity for much of the day, as indicated in Figure 3 by the degrees of saturation over a quiet day (only 2 events: greyhound trials between 7:00 am and 9:00 pm and Torvill and Dean show between 8:00 pm and 10:00 pm) for a sample of intersections.

The lack of pedestrian segregation results in significant traffic delay during major events as signal timings are altered to favour pedestrians.

Public transport provides a high level of service in passenger capacity terms. In most of Southbank the vehicles providing public transport services are part of the general traffic on the roads resulting in similar delays to the traffic, however some of the most congested areas have segregated rights-of-way for trams and buses (eg St Kilda Rd).

This discussion has highlighted three significant elements about the Southbank area transportation system:

- it is a road-based transport system,
- it is a multi-modal system, and
- it has extended levels of high transport demand (typically 6:00 am to 12:00 midnight weekdays and 12:00 noon to 8:00 pm on weekends).

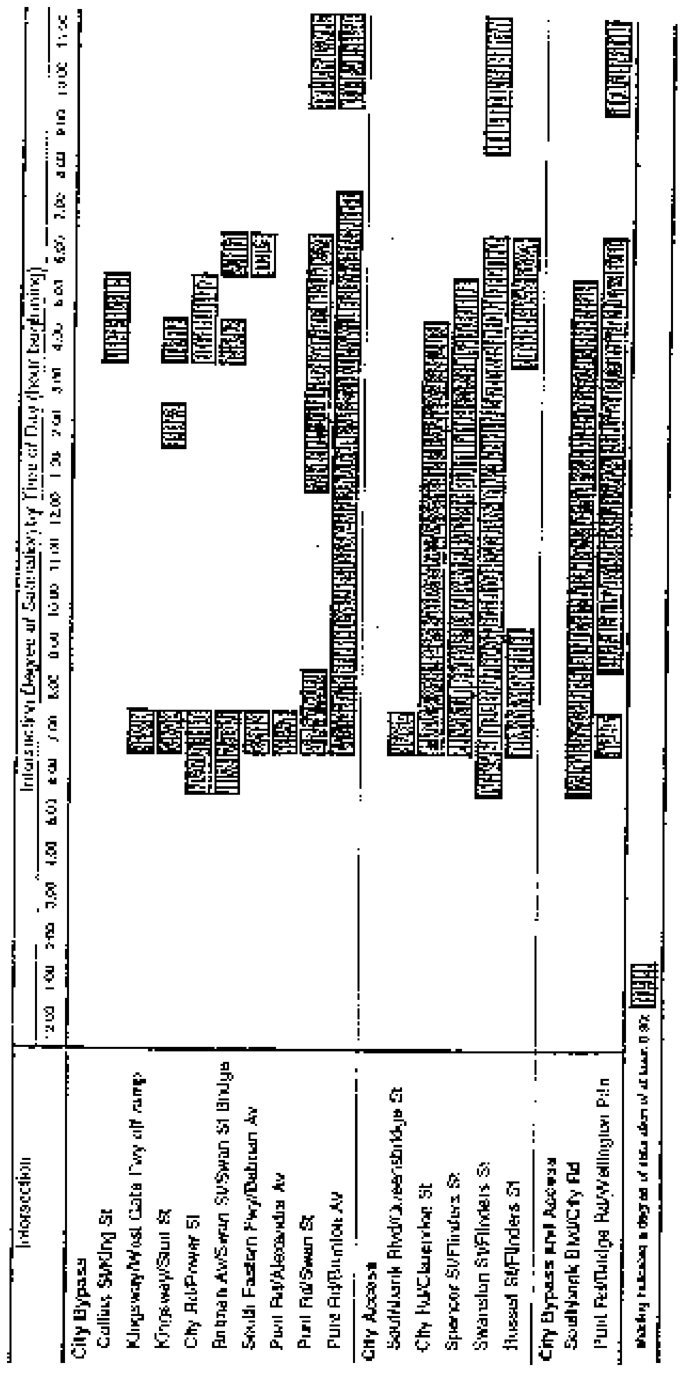

Figure 3 Road Network Levels of Service by Time of Day

3. SCOPE AND ROLE OF ITS

ITS has a number of roles which include;

- directing traffic through optimal design and operation, and
- assisting travellers to make the best decision on why, when and where to travel through the provision of information, eg. where is parking available, where are delays, what public transport services are available, what is the best route, etc.

In order for any ITS to be accepted and used it must be capable of assisting people, ie. it must be customer oriented. This necessitates the system by 'people' friendly and provide useful information. The Southbank area will attract a variety of 'users' and their information needs vary. A well designed ITS would be capable of responding to these diverse information needs. Some people will be familiar with the area and their needs will differ form people who are unfamiliar with the area. We could also distinguish between people who have made the commitment to travel to Southbank, as opposed to potential users and non-users. An ITS could be designed to maximise the number of 'potential' users who are attracted to the area by informing them of events and facilities in the area, traffic conditions, public transport availability and carparking information. 'Non-users' are those who are not destined for the Southbank area but must travel through the area. It is obviously desirable to minimise the inconvenience to this group by providing advice to assist them in avoiding bottlenecks in the area.

Importantly, the role of ITS is not only one of long term traffic management and information provision, once most of the facilities are completed in this area. ITS can play a potentially valuable role during the construction process to assist with traffic management and ensure that people are not put off visiting the area because of perceptions about traffic conditions during construction. In the Southbank area rapid development may cause intense pressure on the transport infrastructure. This growth in traffic needs to be seen in the context of capacity improvements. ITS developments, although they cannot solve problems of excess demand, can nevertheless assist in gaining maximum efficiency from the transport system.

Components of Intelligent Transport Systems

A typical ITS system consists of four main interrelated elements (Fig. 4):

- a method for presenting information to a transport vehicle or user. This may be a collection of roadside message signs displaying a limited set of variable messages, a computer in a vehicle receiving information on the direction of travel or an 'information kiosk' providing details of public transport services;
- a counting mechanism in the transport system that can record the number of cars entering a facility or the availability of seats at a sporting event;
- a control centre that processes data on traffic demand and controls the dissemination of information to the recipients;
- a telecommunications network that facilitates the exchange of information between the traffic system and the end user.

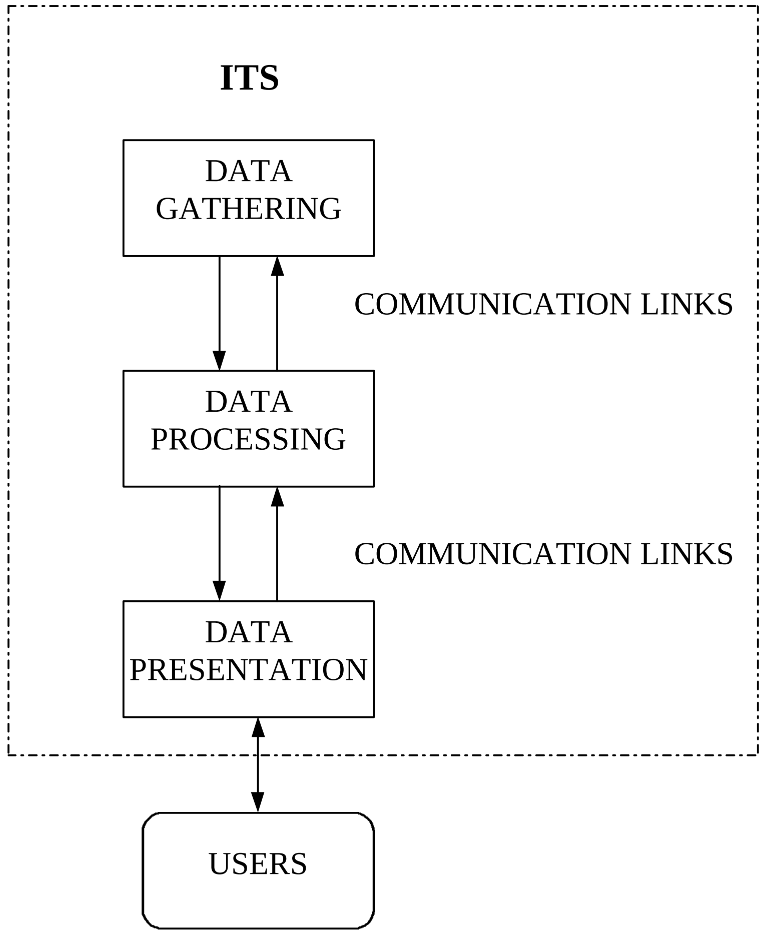

Figure 4 Intelligent Transport Systems Framework

Figure 4 also highlights that the system must interact with users and to be successful must meet their needs. There are many groups that could use the systems. These include:

- Pedestrians, who may seek information on venues/activities, walking distances, location and availability of taxis and other public transport services
- Bicyclists, who may also desire information on the location of secure bicycle parking
- Motorists, who are likely to be the largest market and may be the easiest to access with information, and
- Public transport passengers, who may desire information on availability and access to public transport services

Information Gathering

Several types of information can be gathered through an ITS. Traffic flow in an area is determined by independently counting the number of vehicles that enter and leave the area. The actual counting of vehicles can be carried out in a number of ways:

- by means of a manual tally kept by the operator at a payment desk or entry point. This approach, although costly, may be the only practical method of collecting data at informal parking areas, pedestrian entrances to sporting facilities, in bicycle parking areas, etc.
- by barrier controllers that register a count when a barrier is raised. This approach is common in vehicle parking areas
- by inductive loops buried in the road and parking systems. This approach is common on traffic systems with many intersections and freeways having induction loops to monitor flow while many parking lots have loops to measure flow in and to open and close the barriers
- infra red beacons can be located at the roadside to measure the flow of vehicles past particular points
- ultra sonic detectors mounted over the road can collect information on traffic flow and speed, and
- output from video cameras can be processed to provide information on traffic flow.

The movement of public transport vehicles can be measured using transponders placed on the vehicles or be using GPS. This information can be transmitted to control centres to facilitate monitoring and control of public transport operations.

ITS systems can and will be used for the dissemination of more than just travel information. They will be used to transmit advertising, community and related information. This information can be provided by event promoters or businesses and can include not only those activities which occur regularly but also those that occur less frequently, eg. special events, major concerts, sporting matches, etc.

Data Processing

The data processing functions that need to take place in an ITS include:

- encoding and decoding of data,
- processing traffic data in order to decide upon a suitable set of messages to be sent,
- dispatch of commands to the user,
- monitoring of the performance of the elements of the system, and
- reporting the status of the system (particularly faults) to an operator.

Although some of these functions may be performed locally, the bulk tend to be carried out by a central computer located at the control centre. The operator of the central computer is usually provided with a control panel (or control program) with which to perform three main types of action:

- monitor the status of the ITS system
- acknowledge the receipt of alarms and fault warnings, and

- issue commands directly to the system.

This data processing can be used to determine if there is a need to change traffic signal settings, determine if an incident (accident, large queue, etc.) has formed on the road, determine if people should be informed of the particular traffic situation and how they should be informed, determine appropriate routes to particular destinations and modify public transport operations.

Information Dissemination
In the context of information dissemination consideration must be given to:

- type of information
- method chosen to provide the information, and
- scope of system.

Transport systems cannot work efficiently without appropriate information on the type, location, and availability of elements of the system. There are many types of information that can be provided. These include:

- Spatial location of activities and buildings: Many people will not be familiar with the Southbank area when they enter it. Through one component of the ITS they could be provided with information on the location of buildings or activities they wish to visit, and the relative location of other buildings or activities.

- Entertainment details: In Southbank there may be a variety of activities available at any one time. Information on the time, duration and cost of these activities could be provided through an ITS.

- Traffic conditions: Traffic information on the best route to a location, the travel time to a destination, the level of congestion, the presence of accidents, the existence of maintenance activities could be provided. This would assist not only ‘users’ of the Southbank area but also ‘non-users’ who wish to travel through the area with minimum inconvenience. As noted earlier, communicating details of traffic conditions and alternative routes could be particularly important during construction of major infrastructure like the Domain tunnel/Citylink.

- Parking: Information on parking is essential in an area like Southbank where many people will arrive by car. However, it is not only car parking information that should be provided but bicycle, motorbike, handicapped and other parking types may need to be located. In addition to identifying the location of the facilities people could also be provided with information on the availability of parking at those facilities.

- Advertising: A further dimension of ITS may be their role in advertising forthcoming activities or other activities going on at the same time. This information may include the location, nature of the event/activity, availability of seats, entrance/seat prices, etc. Advertising information could also cover restaurants with details of cuisine, prices and reservation numbers as well as details of collections on display at galleries, etc.

- Access to public transport: Information on the location of public transport access points, schedules, etc. can be provided. This information can be provided within the Southbank area or could be provided before people make the trip, ie. into their homes/workplaces, in an effort to influence mode choice decisions.

Whilst it is easy to identify a wealth of information which could be provided it is essential to ensure that the recipient is not overloaded with information. This can result in the person not using the information system or more drastically the distraction of the user from the main task, eg. driving a car and a consequent accident. Further, it is necessary to determine carefully the type of information that should be provided. The type of information could influence decisions. However, if it is poorly located or presented it may not have the desired impact.

Information can be presented in many ways including maps, information boards, radio broadcasts, road signs and pavement markings (Young 1986, 1987). Methods of disseminating information include:

- Roadside**:** The most common method of providing traffic information is roadside signs. These have the advantage that they are easy to introduce, are familiar to drivers and do not require in-vehicle systems. Their disadvantages include the limitation on how much information can be displayed if motorists are to absorb it and the visual impact of the large Variable Message Signs (VMS). Information for public transport use can also be provided from roadside signs.

- Radio**:** Radio is a common method of providing information to drivers which has the advantage that it is easily introduced at a relatively low cost. Some commercial radio stations broadcast traffic reports during peak periods. One disadvantage of these radio broadcasts is that motorists must listen to the entire broadcast and select information relevant to their needs. These traffic broadcasts are often brief and may be transmitted at irregular times. Dedicated traffic information channels can be established and technology is available for local area transmission which would provide a driver with information relevant to the area in which they are travelling. A system like this could be established to cover the Southbank area. There may be opposition from commercial radio stations to development of dedicated traffic information channels because the commercial stations are reluctant to encourage people to tune away from their channel in case they do not tune in again.

- In-vehicle computers**:** Considerable development is taking place in the area of introducing computer monitors into vehicles. These monitors provide information to the driver. The advantages of these systems are their flexibility, capability to access information in a non-sequential fashion and the vast range of information which can be presented. The disadvantages are that it is costly, is still in the development stage and there may be a slow take up by the motoring market given the rate of turnover of the Australian vehicle fleet. Another issue is the rapidity of development may result in some systems not being upwardly compatible. No doubt, in-vehicle systems have considerable advantages but they are likely to be a long term option.

- Information kiosk**:** The concept of electronic information kiosks is becoming accepted by the public, eg. in-store systems in major department stores and systems in place at some city loop railway stations. These systems often employ touch screen technology and have the advantage that they can provide general information to users in a variety of locations, eg. around the Southbank precinct, at a venue, in the CBD, and in regional centres. These systems must be designed to be very user friendly and there is a need for security against vandalism. There is also the possibility of extending the information kiosk concept by taking the information into the home or workplace via TV or computer. VicRoads currently disseminates traffic reports via the AUSTEXT service provided by a commercial TV station. A similar system could be set up with information dedicated to the Southbank area.

- Phone-based systems**:** A useful communication medium is the home or mobile telephone. The system could operate like a 0055 number with dialling options once you access the service, eg. *dial 1* for traffic information, *dial 2* for events at the MCG, etc. Information provided could include parking information/availability/price, public transport services, special events and ticket prices. This type of system is well established in the USA and is becoming more common with businesses in Australia. The public can already obtain information on travel times on Melbourne's South Eastern Freeway by phoning the DriveTime Information System.

ITS can provide information at a number of levels. They can provide overall urban information or local information. The type of system adopted must reflect the spatial character of the information needs. At an urban level, radio or in-vehicle computers can provide appropriate information. While at the local level, street signs and on-road changeable/variable message signs may be more appropriate.

Communication
Information can be transmitted via radio waves, digital transmission lines or fibre optic cables. As noted in the previous section, the options for radio transmission include broad or narrow cast. Narrow cast option can be further subdivided into sub area specific messages versus broadcasting the same message to the entire area, eg. for the whole Southbank area. A major element in the transmission of data is the communications network of which there are two main types.

- dedicated networks consisting of specially laid cables and infrastructure;
- existing, generally public, networks.

Whilst there are considerable cost advantages to be gained by using an existing communications network, limits on the number of free data channels or on the quality of the transmitted signal sometimes means that a dedicated system is the only feasible approach. Fibre optical systems provide the opportunity to transmit more information more quickly.

Existing Systems

The preceding discussion has introduced the components of ITS systems and general activities in the research and development area. While Australia is a leader in areas like automated signal control (SCATS), automated incident detection on freeways (Snell, Sin and Luk, 1992) and public transport monitoring and priority, this section will concentrate on some particular developments which are of broader interest.

Traveller information
The previous discussion has concentrated on techniques to guide traffic using traffic control. A variation on this approach is to provide the road user with information to assist them in meeting their desires and allowing the user to make the choice. These can be divided into roadside information systems, parking guidance information systems, public transport information systems and advanced traveller information systems. The characteristics of these systems are briefly review below.

Roadside information systems
Roadside information systems have been developed in a number of countries for freeway and arterial applications.

In Japan, the Metropolitan Expressways' Traffic Control System (MEPC 1992) has been developed in Tokyo and it comprises three major components:

- Data Collection: Traffic information is collected using ultrasonic detectors to measure speed and flow, video surveillance cameras to monitor particular danger points in the traffic system, emergency telephones, patrol cars and the weather bureau.
- Data processing: The raw data is synthesised and presented in a graphical and picture form. The information is then sent back to be displayed to drivers.
- Data presentation: Information is presented to the drivers in many forms which include:
    - character information boards mounted on gantries over the road to provide information on speeds, traffic flow conditions and lane choice with updates every minute,
    - information corners with maps of the traffic system provide information on general traffic conditions to drivers at parking stations and other locations so they are aware of general traffic conditions and can plan their trip,
    - graphical information boards mounted over the road that provide information on traffic conditions on particular routes using maps on which congested areas are lit up using a red marking
    - radio broadcasts provide up-to-date information to drivers on conditions in particular parts of the transport system and drivers are advised of the frequency of the broadcasts using roadside information boards.

Similar systems are under development in the USA and Europe. VicRoads has implemented DriveTime, a major roadside travel time information system (Hearn, 1995) on one of Melbourne's freeways (the South Eastern) and there are plans to extend the coverage of the system.

Over the past decade increasing attention has been focused on the use of parking guidance and information (PGI) systems as a means of combating some of the problems of parking congestion. In broad terms, these systems aim to provide information to drivers concerning the location of, direction to and availability of parking spaces. They thereby encourage more efficient use of the parking stock and reduce the amount of parking search traffic within an urban area. As such, PGI systems may be seen as a component of the traffic management and control response to urban traffic problems. Parking guidance systems have been extensively deployed in Europe with Polak et al (1989) reviewing the characteristics of some fifty known PGI systems operational in the UK and Germany in the late 1980's. The Melbourne City Council launched Australia's first car parking guidance system in 1985. This system could be extended and/or enhanced to cater for the Southbank area.

The PGI systems considered in this section are characterised by the use of roadside variable message signs (VMS) to convey information to drivers concerning the location, direction and availability of parking.

A typical PGI system consists of four main interrelated elements:

- a collection of roadside Vehicle Message Signs (VMS) capable of displaying a limited set of static and (pre-defined) variable messages,
- a counting mechanism at car parks that can record the number of cars entering and leaving a facility and thus enable the calculation of car park occupancy,
- a control centre that processes data on car park occupancy and controls the display of information on the VMS, and
- a telecommunications network that facilitates the exchange of information between car park, control centre and VMS's.

Although the essential relationship between the elements of a PGI system is in principle quite simple, in practice, the structure of real PGI systems can be considerably more complicated. In particular, the need to be able to detect equipment failures and take appropriate corrective action, the need to accommodate the transmission of information over diverse telecommunications channels and the need to enable manual control to operate when necessary gives rise to additional information flows within the system.

Existing PGI systems set out to provide drivers with three broad classes of parking related information:

- information on the location of car parks,
- information on the direction or route to take to car parks, and
- information on the availability of spaces at car parks.

The locational information provided in PGI systems is important since it may enable drivers to choose a car park close to their final destination and thereby reduce the time they spend walking. A reduction in access and egress movements in car parks may have the additional benefit of reducing the overall volume of pedestrian movements. The location of car parks is generally indicated in one of three ways:

- by explicitly naming car parks by means of a street name or a feature name,
- by naming the locality or area served by a group car parks,
- by naming the specific facilities such as sports complexes or department stores that are served by the car parks, eg. 'Tennis Centre'.

PGI systems provide direction and routing information in order to help drivers to navigate to a car park. By so doing, PGI systems may serve to reduce drivers total travel time and may help to reduce the overall amount of parking search traffic in a central area.

The core element in most PGI systems is the provision of parking availability information. In circumstances of severe parking congestion, where parking spaces are scarce and there is competition between drivers for those that are available, intelligible and reliable availability information may enable drivers to reduce their searching time by preventing them travelling to facilities that are already full. In this way, it is argued, the provision of parking availability information may also bring about a reduction in overall traffic volumes.

Assuming that reliable availability information is at hand, an important question exists as to how it should be displayed to drivers. A number of different approaches are evident in existing PGI systems. The most common approach is to convey availability in terms of a number of discrete named levels. A minimum of three levels is normally used. These levels are typically name *FULL*, *SPACES*, AND *CLOSED*. In some systems the message *SPACES* is explicitly displayed, often with an accompanying arrow giving direction information, whilst in others, the *SPACES* message is implicitly conveyed by the presence of a direction arrow alone. The PGI installed by Melbourne City Council in 1985 provides details of the number of spaced available.

Consideration also needs to be given to different categories of users. This is important for two reasons:

- certain categories of user may be directly implicated in particular policy objectives, eg. policies designed to improve accessibility for shoppers or casino visitors, or to deal with parking or traffic congestion caused by major sporting events at the Tennis Centre or the MCG, etc.;
- more generally, the characteristics of users (in terms of local experience, willingness to pay, journey purpose, etc.) will affect their requirements for information, their ability to recognise and comprehend the information which is provided and their willingness to change their behaviour in response to the information.

The designers of PGI systems must therefore identify and describe the class or classes of users for whom the PGI system is intended and formulate the system design accordingly. From this point of view, a particularly important dimension of classification is that based on the existing knowledge a driver has of the area and its parking facilities. At one extreme, there will exist a class of drivers with thorough and detailed knowledge of a locality (experienced) based perhaps on frequent visits as a commuter or shopper. At the other extreme, there will be class of drivers who know little or nothing about an area or its parking facilities (innocent); for example, Melbourne residents or visitors travelling in to spend time at the casino. Although this dichotomous classification is clearly an over-simplification, it provides a useful basis for the examination of user-related considerations.

In order to be effective in guiding a driver to a car park near to the final destination, signing by car park name requires that the driver has a relatively high degree of local knowledge. For experienced drivers, and especially for those with strong preferences for particular car parks, this form of signing may work well. However, the innocent driver may find difficulty in relating named car parks to their final destination, and would benefit instead from signing by area, or even from signing by facility (providing, of course, that such drivers have a named facility as their destination).

Not only do different classes of driver vary markedly in their requirements for and ability to utilise information, they may also differ significantly in terms of their willingness to modify their behaviour in response to parking information. Clearly, local experience can also be a relevant consideration here: experienced drivers may have established behavioural routines or strong local parking preferences that militate against change (especially in the context of a prescriptive information dissemination strategy). On the other hand, innocent drivers with few pre-conceived ideas about local parking conditions may be more receptive to parking information and more willing to comply with advisory information, even of a prescriptive kind.

Other factors relevant to the issue of the ability to modify behaviour will include journey purpose and willingness to pay. For example, individuals travelling to the MCG with reserved seats in a particular part of the stadium may be unwilling to be diverted to a car park that is significantly more remote than their first choice car park and final destination, while holiday makers or leisure visitors heading to the Southbank area for a night out may be more willing to tolerate a diversion to a guaranteed free space.

In the longer term, the introduction of in-vehicle information systems may provide an alternate means of transmitting guidance information to the driver. These systems may make the large visually intrusive signs associated with these systems unnecessary.

Public transport information systems aim to improve the efficiency and convenience of public transport, as well as ensuring transit priority of buses and other high occupancy vehicles. Their functions are to give priority to public transport vehicles, provide travel time information, provide information on travel location and set up and clear bus lanes. Public transport information can also be supplied at particular points in the area. This information is usually provided in the vicinity of the stations. However, timetable information could be provided directly to people at home, the office or other locations via telephone or computer links.

Australia has been active in the development of public transport information systems. In Melbourne, for example, train arrival information is relayed to passengers using on-station signs. In Sydney, an Automatic Network Travel Time System (ANTTS) is used to advise passengers of bus arrival times (Quail and West, 1992). The Sydney system employs a low cost vehicle tag which is fitted to each bus operating on the routes connecting the CAD and the airport. When a tagged vehicle passes through an intersection equipped with an interrogator the tag transmits its unique identification code to the interrogator which in turn sends the code to the central computer along with a time stamp. These data are used to locate vehicles and predict their arrival times at stops. Arrival time information is communicated to passengers at selected stops using variable message signs. Similar technology could be used in the Southbank area to advise passengers of arrival times of public transport services.

There is also increasing interest overseas in more advanced public transport information systems. For example, the ROMANSE project (Mansfield 1994) being carried out in Southampton (England), Cologne (Germany) and Piraeus (Greece) aims to develop an information system for public transport to increase its usage. The system aims to provide a travel and traffic information centre which collects information together from a number of areas. The information is provided to users through FM radio and teletext. The system also provides strategic information for planning, monitoring and the management of traffic flows.

Recent US experience highlights the potential benefits an Advanced Traveller Information System (ATMS) could provide for Southbank. An ATMS is being developed to assist in traffic management for Yosemite National Park in California (Jovanis, 1994). The system will include information kiosks located throughout the park which will provide details of traffic congestion in the park and accommodation availability. This information will also be available via telephone/computer links to individuals at home who are considering travelling to the park. In the past, people have been put off travelling because of radio bulletins which erroneously predict major traffic problems in the park. As a result, in some holiday periods, accommodation has been vacant in the park with obvious effects on the operator’s revenue. In an analogous way, an ITS could have an important role to play in the Southbank area by ensuring that potential visitors have up-to-date information on traffic conditions, public transport services and activities to ensure that the maximum use is made of the Southbank area. This would promote the area’s social and economic prosperity.

4. TOWARDS A SOUTHBANK ITS STRATEGY

This paper has highlighted some of the developments in ITS around the world and outlined their relevance to the Southbank area. The development of any ITS for the Southbank area in the near future should be based on existing technology with appropriate recognition of future developments. ITS technology options presently available include variable message roadside signs, radio broadcasts, information kiosks and telephone information services.

For motorised vehicles, roadside systems appear to present the best option for parking and traffic information. New presentation boards using fibre optics may allow this technique to be generalised to handle other information. However, the most likely form of information dissemination of advertising information would be billboards, radio and television systems. Information for pedestrians needs to be provided on or near main thoroughfares. Localised information booths or kiosks could be set up to provide information on entertainment, activities and places of interest.

Public transport information could also be provided to people using the Southbank area. The Flinders Station information could be relayed to Southbank with a delay time built in so that people could be advised of when they would have to leave to catch particular public transport services.

An ITS for Southbank will consist of a number of components which will need to be tailored to the needs of particular users. Radio, television and telephone systems have the advantage of reaching an urban-wide audience. These systems should be developed and could be integrated with future developments in ITS technology. The use of these systems to advertise traffic problems and other information could enhance the attractiveness of the Southbank area. Roadside systems can provide detailed information about the state of traffic and parking within the Southbank area. The linear nature of the Southbank development, based as it is on the South Eastern Freeway and its extensions, lends itself to roadside information providing directions to parking and other facilities.

When defining an ITS for the Southbank area one must realise that there is rapid development in the level of technology available. A system developed at one point in time will almost certainly not be at the forefront of technology in a few years. That is not to say the system is not of use, but rather than more sophisticated systems will be in existence. In-vehicle systems are being developed and fitted into vehicles overseas and in some expensive models locally. However, their introduction is going to take time and immediate benefits are unlikely to be large if this route is taken. In the long term this approach is likely to be very useful and steps should be taken to ensure that Southbank information is provided to users with access to this technology.

One could argue that an ITS needs to be upwardly compatible thereby ensuring that it can be incorporated into future systems which may be more sophisticated. This could be achieved to some extent given that information provided via radio, television or a telephone system as well as local information on traffic and parking systems could also be provided through other systems. However, it is unlikely that total upward compatibility is likely to be achieved and some redundancy in older systems is likely to be created. This is inevitable in an area like ITS where rapid technological developments are occurring. However, in this, as in other applications, delaying a decision until the *ultimate* system is available imposes a high opportunity cost in terms of benefits which could have accrued from earlier introduction of a less sophisticated system. The Southbank area stands to benefit not only in the long term, but also during the period when much of the area is being developed, from investment in an ITS to cater for the diverse needs of the many people who will visit Melbourne’s entertainment, sporting and cultural hub.

Importantly, the development of ITS overseas, particularly in the USA, is emphasising a partnership between the public and private sectors. There are a variety of opportunities for providing 'value-added services' within an ITS. The private sector could become involved in the development of the systems or through the provision of information about events at particular venues etc. which could attract advertising income for the system.

5. SUMMARY AND CONCLUSIONS

The Southbank area is achieving prominence as an activity centre because of the variety of cultural, sporting and entertainment opportunities which it provides. This paper outlines opportunities to maximise the economic and social value of the area by facilitating travel to and through the area. The focus here concerns the integration of 'intelligent transport systems' (ITS) into the Southbank area. ITS covers the application of advanced information processing and communications, sensing and control technologies to surface transport. ITS will assist in the reduction of traffic congestion and inconvenience to drivers, public transport users, pedestrians, bicyclists and other travellers. These systems may also reduce fuel consumption, traffic noise and emissions. ITS has a number of roles which include:

- directing traffic through optimal design and operation, and
- assisting travellers to make the best decision on why, when and where to travel through the provision of information, eg. where is parking available, where are delays, what public transport services are available, what is the best route, etc.

Importantly, the role of ITS is not only one of long term traffic management and information provision, once most of the facilities are completed in this area. ITS can play a potentially valuable role during the construction process to assist with traffic management and ensure that people are not put off visiting the area because of perceptions about traffic conditions during construction.

The level of technology that is presently available revolves around variable message roadside signs, radio broadcasts and telephone services. For motorised vehicles, roadside systems appear to present the best option for parking and traffic information. Radio and television systems have the advantage of reaching an urban-wide audience while the roadside systems can focus on particular areas. The linear nature of the Southbank area and associated transport infrastructure lends itself to roadside information providing directions to parking and other facilities. In the long term in-vehicle systems are likely to be very useful. Information for pedestrians could be provided in localised information booths or kiosks. This information could relate to entertainment, places of interest, public transport timetables, provisions of taxi services and parking.

The Southbank area stands to benefit not only in the long term, but also during the period when much of the area is being developed, from investment in an ITS to cater for the diverse needs of the many people who will visit Melbourne's entertainment, sporting and cultural hub.

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