INTEGRATED DEMAND-RESPONSIVE URBAN PASSENGER AND FREIGHT TRANSPORT

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ABSTRACT: *This paper discussed how the temporal and spatial variations in the demand for urban passenger and freight capacity could be used to increase the productivity of existing manpower and vehicles in urban public transport operations through co-ordination of passenger and courier type parcel freight operations. Likely problems in the conversion of vehicles and drivers from one role to the other are discussed from an engineering, labour-management, institutional and potential user point of view. Advantages are seen in terms of improved levels of service, especially in off-peak periods when services operate in a demand-responsive manner, and in decreased subsidies. Integration of freight and passenger transport is not seen as a panacea to the urban transport problem, but as one step in the restructuring of the urban movement system to help align it with existing urban geography in an environmentally responsible manner. A possible application in Canberra is outlined.*

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This paper advocates an approach to urban transport which may encourage a better use of some transport infrastructure. The basic idea proposed here, is that a significant proportion of the transport task in urban areas relating to public passenger services, and to the cartage of small parcel freight, could and should be performed by the same vehicles and manpower. It is not suggested that both functions should be carried on simultaneously by the same vehicle hardware and manpower resources. Rather advantage should be taken of the temporal and spatial variations in demand for passenger and freight carrying capacity, to deploy transport equipment and manpower in either passenger or freight roles so that their levels of productivity can be increased substantially.

Integrated freight and passenger services are not new. Intercity buses often carry freight. Modern jet aircraft with their increasing payload capacities, can and do seek the carriage of freight to supplement the passenger transport role. Quick reconfiguration capabilities in the same aircraft permit the allocation of cabin space, as against hold space, for carrying freight. Historically, and even to this day, much rural road transport combines the roles of passenger, mail and other delivery type services

For intra-urban transport, the movement requirements of people and of goods, has encouraged the separate development of facilities and organisations to meet both tasks, often to the detriment of much consideration relating to the interdependencies between goods and people movement.

Characteristics of urban freight consignments as outlined by Meyburg and Stopher (1974) concerning physical properties, mass, volume, shape, value, perishability, origins and destinations and temporal handling requirements, may encourage the development of specialist vehicle types and related equipment to perform the transport task efficiently. Even excluding such specialist vehicles as bulk tankers, refrigerated vans, or armoured bank cars and the like, there remain many general goods pick-up and delivery vehicles working in urban areas handling many small consignments averaging no more than 35 kg in weight

It is suggested that we may well take some lessons from the past, combine them with presently available transport technology, and organisationally create a transport capability which can serve some segments of both passenger and freight demand within urban areas. At different times of the day, a particular vehicle and its driver may be engaged solely in the transport of passengers. At other times the same vehicle and driver may be used to satisfy urban goods movement demand. The key feature of such a system, designed to supplement more specialist transport capability, is that it should be a simple process for both vehicle and manpower to be switched from one role to the other as both spatial and temporal demand conditions change.

There is a social need for public urban passenger transport capability in all Australian cities. Most existing passenger services, particularly those serving sprawling low density suburban housing areas, habitually run at a loss and require subsidy from the public purse. Levels of service also fall short of the expectations of potential customers who opt for their own private motor vehicles. It is suggested that operating deficits for public passenger transport could be substantially reduced, and the quality of service to customers noticeably improved if a segment of the urban freight transport task were also undertaken by the public transport authority. It would also be a step in the direction of ameliorating the urban transport problem and acting in an environmentally responsible manner with respect to the consumption of scarce

resources.

1.1 THE URBAN TRANSPORT PROBLEM

The urban transport problem has been defined as 'lack of mobility, severly limited mobility, or mobility purchased at very high social and economic cost' (Smerk 1972) Causes for this malaise are seen in terms of the shift of population to the suburbs, failure to understand the automotive revolution, failure to assign properly the costs and prices associated with transport, the decline of mass transport and lack of skill in transit management, apathy on the part of elected officials in the multiplicity of communities comprising the metropolis, and general lack of funds.

Continuing technological changes in transport and in methods of operation have many diverse effects on housing, employment, recreation and mobility aspirations and possibilities. The present day morphology of cities, especially in the Western world, owes much to changing transport technology and rising economic affluence which has equipped many families with at least one automobile and often two or more.

The process of suburban sprawl at low housing densities has been accelerated by the move from dependence upon fixed route public transport systems such as trams and suburban railways. Indeed, unless reserved through careful foresight, open public space in many modern metropolii is lost to competing land uses for which there is a greater immediate economic return, ignoring the longer term consequences (Platt 1971).

Having once enjoyed the luxury of private transport, it is certain that the travelling public will demand a much higher standard of service from public transport if they are to be weaned from their private cocoons. This will be despite the increasing capital and running costs, let alone the frustrations from never ending traffic snarls and searches for elusive parking spaces.

1.2 AN IDEAL PASSENGER TRANSPORT SYSTEM

If both users and non users of various forms of transport were asked to outline the criteria by which they would judge the utility and acceptability of those forms of transport, the list of requirements would be numerous. Whether for passenger or freight movements, factors such as cost, travel time, frequency of service, dependability, comfort and safety would undoubtably be mentioned by customers, whereas those non users affected by the transport system would tend to stress broader social and environmental issues.

The theoretically ideal means of passenger transport would ensure that the system was mechanically safe. It would minimise physiological discomfort or strain for both driver and passenger, be easy to interchange with connecting systems, offer personal privacy and access to ancillary amenities, and permit an awareness of such things as motion, place, space and climate if so desired As many users prefer their own individual control of the vehicle, the system structure would allow users to find their way about with little or no frustration from lack of easily understood and available information. Variety within the system would ensure considerable choice for users in terms of routes, vehicle types, personal space, social space and environmental experience. No groups within society would be excluded from using the system be they old, young, poor, physically handicapped or disadvantaged in some other way.

At the same time as meeting these requirements for users, the ideal passenger transport system would not annoy non users with excessive noise,

vibration, glare, shading, fumes, dust, or invasion of privacy It would blend into its surroundings rather than dominate local environments, enhancing rather than destroying landscape elements considered of value in the community Functional and visual connections and local neighbourhood identities would be reinforced rather than fractured by the presence of such a transport system.

1.3 CONSTRAINTS ON THE DEVELOPMENT OF AN IDEAL SYSTEM

No such ideal transport system has yet been devised because, quite obviously, the list of desirable attributes is incapable of being maximised simultaneously and not all users and non users would place equal weight on the realisation of standards were it possible for these standards to be agreed in the first place Governments also must weigh conflicting demands upon resources against each other. Competing needs in other sectors such as education, health, manufacturing and agriculture etc. may induce implementation of decisions which are less than optimum from a technical transport point of view (Halton 1976).

It will not be an easy task to turn the clock back, so to speak, and increase the percentage of urban journeys taken in other than the private automobile. Many modern suburban developments have been planned from the outset with the private vehicle in mind. Special rights of way for public transport are in many instances completely non existant. Narrow curvilinear suburban streets laid down purposefully to force local traffic to slow for safety reasons and discourage any through traffic, are nevertheless a nightmare for designers of public bus routes. Where bus services exist at all in these circumstances, they tend to be highly circuitous and offer little incentive to potential users who can take much more direct routes in their own vehicles. Extensive areas of land around suburban shopping centres are given over to car parks to cater for the resultant automobile oriented clientele. All too often, the public transport terminals at shopping centres are peripheral and unattractive. Bus routes along the routeways are lucky to consist of anything more than a signpost without shelter or timetable information.

The rundown and demise of a city public transport service is often attributed to rising operational costs which cannot be recouped through the fare box. Labour costs can account for in excess of 70 per cent of these costs. Any solutions which are less labour intensive tend to irk the trade unions involved and lead to industrial unrest as workers fear for their jobs. On the other hand, rising fares to cover rising costs merely serve to reinforce the desire of most passengers to quit public transport in favour of private means if at all possible. Once the capital investment in a private automobile is made, the difference in running expenses *seems* marginal to many, and they might just as well make use of the vehicle. They will need it anyway for some trips for which public transport is quite unsuited. It is also nice to know that one can make a trip on the spur of the moment without having to think ahead about bus timetables and connections. Essentially, the out of pocket cost differences between private and public transport would have to be widened considerably before that factor alone is likely to induce many people to switch in favour of public transport. If all individuals and businesses were faced with something like the true social costs of their travel alternatives, travel demands would possibly be reduced, but certainly spread in time and place and made less reliant upon private automobile ownership.

Another reason for the unpopularity of some public passenger transport services stems from the fact that operators, through historical accident, economic stringencies, or plain bad management, have been forced to continue in use antiquated equipment whose down time for repairs is excessive. Even reliable equipment can quickly become 'old and dowdy' when compared with the

latest designs. For a ridership who prefer to be masters of their own destiny in a vehicle which allows individualised timetabling and the flexibility to go virtually anywhere, there is little attraction in a public transport system whose dependability is suspect, and whose interior fittings do not permit comparable levels of comfort, personal privacy, and space for the storage of personal paraphenalia. Automobile users still suffer the stress conditions from driving in crowded traffic and hunting for a legal parking space, but they do not seem eager to trade these stresses for those they must face when constrained to using public transport services

1.4 NEW TECHNOLOGY PROBLEMS

One may well ponder the question as to why very little radically new urban passenger movement technology has gone further than the drawing board on prototype test stage. A major inhibiting factor must be the size of the problem. Huge amounts of capital and material resources would be required to develop new public transport technologies capable of competing with the private automobile, but at the same time distributing the benefits in a more equitable manner and with less adverse environmental impact. There is no certainty that the developmental effort would lead to successful adoption. Unlike the present automobile industry which has some assurance of the marketability of its products, there can be no such guarantee that the general public will embrace some completely new form of urban transit (Garrison 1969). Without committed sponsors for such innovative work, it is unlikely that urban transport technology will advance other than in small incremental changes to existing means. More likely is the possibility of seeing existing 'off the shelf' technology used in new ways where organisation and information are the controlling factors ensuring successful operation.

Without implementation of planning strategies to change life styles that might reduce total demand for mobility, distribute demand more evenly in time and space, and improve the operating efficiency of existing transport supply, it is unlikely that the demand for more transport facilities will lessen. However, no one transport technology can hope to meet all the movement needs of an urbanised society. Any attempt to use one technology to the exclusion of others will set limits on the growth options and efficiency in urban development (Alderson 1968). Obviously different means of transport operate best in different environments. An over reliance upon the private automobile calls for compensatory measures to make alternative means of movement more attractive and efficient.

1.5 INSTITUTIONAL BARRIERS

Perhaps the greatest stumbling blocks in the search for complementary travel alternatives to the private automobile are institutional barriers. The evolution of our economic and social systems has seen increased specialisation in knowledge, activity and occupational behaviour, and in the number of institutions and levels of organisation required to order that system. To change established areas of responsibility, regulation, control and customary procedures is no easy task given the inherent inertia in much organisational behaviour. The performance of the transport task in urban areas has likewise become very specialised and controlled by many diverse authorities. Both jobs and vehicles are specialised. Freight and passenger systems tend to run independently. Private and public modes may vie for the use of common facilities for different end objectives. The end result of our spatial and functional organisation of society and forms of transport, is that parts of the urban area have excess transport capacity whilst others are chronically congested at particular times of the day. The rolling stock is likewise idle for many hours

on end, or hard pressed to meet peak demands.

Before seeking any completely new form of transport to add to the pool of alternatives available for urban transport tasks, it would seem logical to explore ways and means of maximising the productivity of existing forms.

1 6 GREATER PRODUCTIVITY FROM EXISTING SYSTEMS

One organisational development which may go some way towards alleviating some aspects of the urban transport problem is to reintegrate passenger and freight transport services in urban areas, and to operate them when possible on a demand responsive basis. In the passenger sphere, taxis are the best example of a demand responsive system. Radio controlled despatching can keep the amount of 'dead' running to a minimum. Small parcel courier delivery systems in many metropolitan areas offer a similar service in the freight business. An essential feature of demand responsive systems is that they provide services only when there is a demand, either pre-booked or requested just prior to need.

It is a fact that peak demands for passenger capacity associated with the journey to and from work tends not to coincide with the demands for small parcel freight pick-up and delivery capacity in many urban areas. The peaking of demand associated with the journey to and from work is well known. Similarly, commercial vehicles engaged on pick-up and delivery services to business houses and offices tend not to be welcome outside normal employment hours. There is therefore a natural temporal separation in peak demand for both types of transport which may be turned to advantage in any dual purpose operation.

Bus operators have long sought to find special unscheduled demands for their buses in off peak times. They also find it difficult to utilise effectively the manpower they must employ for peak traffic times at other times. So long as transit operators confine their search for extended use of their vehicles to passenger applications, then there seems little opportunity to do more than what is presently accomplished. The income earning potential of a dual use vehicle must be greater.

Whether in the passenger of freight role, customers could be offered essentially door to door services. Efficient manual or computed aided despatching is needed to ensure that several requests can be aggregated in time and space so that they share the one vehicle, thus lowering the costs to users. It can be seen in the passenger role as an attempt to retain some of the more desirable characteristics of private automobiles and taxis, particularly door to door service and availability when required, in a timespan which will compare reasonably well with non-sharing systems.

1.7 SERVICE AREAS

To obtain sufficiently attractive levels of service it is necessary to restrict the geographical area within which the passenger vehicle operates, and the size of the vehicle. Attempts in the past to provide many to many type passenger services on a metropolitan wide basis have seen little success. In some cases, the latent demand for transport over routes not previously serviced by public transport, immediately proved embarassingly large (e.g. Adelaide).

The use of conventional-sized buses in demand responsive systems has two distinct drawbacks. Firstly, attempts to fill the seats of such a bus by detouring for additional passengers, increases the average transit time for all riders. Secondly, the larger buses cannot penetrate the narrow residential streets to provide the door to door service. Small mini-buses seating

approximately 12-15 people are far more appropriate for such a service, but not too small that they cannot be considered for the alternative role of parcel freight carriers.

In particular instances, demand responsive bus systems may operate metropolitan wide in that a single vehicle would not be confined to a particular zone Service to or from a major transport terminus such as an airport is such a case. Normally, however, to travel throughout a metropolitan area using a demand-responsive type of bus service, it would be necessary to use the local neighbourhood services at either end of a separate, but integrated, line haul operation, to travel door to door completely across town

Where the small demand responsive bus can probably be integrated best into a metropolitan transport system, is when it serves a clearly designated suburban housing area, linking that catchment to a well designed interchange often at the regional shopping centre and mass transit terminal Larger conventional buses and other forms of mass transit are retained for the purpose for which they are best suited, namely the line haul operation. During peak travel demand periods, the small mini bus can shuttle passengers between its zone and the interchange. It may deviate door to door in the peak travel time, but more likely it can ply a fixed route, offering better coverage than by a large bus, and link with the non stop cross-town line haul services. In the off peak passenger travel periods, if still retained in its passenger role, it could certainly provide the many to many type service within its own zone.

Provided that the demand responsive mini bus services are well integrated with the major line haul services such as suburban trains, and the mini buses from adjacent suburbs all meet at the same interchange to allow local transfer, then there exists the possibility of providing public transport at a high level of service in concert with today's geography of residential living. Many trips for work, shopping and recreation can compete for the one family automobile and produce pressure for purchase of a second car. However, such pressure could be lessened considerably if the demand responsive bus system were available. The extra-curricular activities of school children for music, swimming or ballet lessons and for sports or visits to friends, need not require one parent or other to act as chauffer when reliable public transport can offer the security of a door to door service. Late night services when demand is low could be met by a single mini bus serving several adjacent suburbs.

In the off peak passenger travel time, several of the suburban mini buses can switch to their alternate role, but one which may be even more remunerative. That is, they can be converted into parcel courier vehicles. Many city business houses and retail outlets, and government departments maintain their own fleets of courier delivery vehicles. Much of the work to which they attend during the course of a working day could be undertaken by the demand responsive vehicles of a city wide transport authority.

1.8 ADVANTAGES

A number of advantages to the community could stem from the introduction of such a philosophy. In the first instance, fewer total vehicle registrations would be required, as those used would be deployed in a more productive manner. With fleet standardisation, maintenance costs could be kept as low as possible. Backup capacity would be more assured. Off street loading and unloading facilities may be provided more readily for the mini buses than for larger trucks. Vehicle manufacturers may see more sense in making design modifications to their products if large numbers of dual purpose vehicles can be absorbed in the market. It would not be out of place for the metropolitan

transport authority to contract to carry mail bags for the post office, or undertake similar regular office hours or after hours work for other Government Departments.

One of the reasons why individuals are often so loath to abstain from using their private automobile is because it can act as a shopping basket and carrying device for personal belongings and goods just purchased. Public passenger vehicles are usually poorly equipped to cater for this type of demand. If, however, a user of demand responsive transport is given the opportunity to both ride the service from his front gate and to have his shop purchases delivered in like manner at a convenient time by the same system, then one strong objection to the use of public transport can be removed. The advertising agent might amend the slogan "travel by bus — no parking fuss" to one that read "and no parcel fuss". Women who are forced to shop with toddlers and strollers could avoid the additional hassle of struggling with bags of groceries or other merchandise by using the parcel delivery service of a dual purpose demand responsive public transport system.

Those who live in the highly urbanised areas of the developed world can understand why transport has become a prime focus for environmental attention. Today's traffic is obtrusive to most of the senses. To produce and operate many forms of modern transport, especially in urban areas, has required what many people consider a profligate use of energy, especially of the non-renewable types. Advanced western societies have developed physical and social structures which require relatively larger inputs of energy and other material resources each decade to do essentially the same task with little apparent gain in comfort or convenience. At the same time, many city neighbourhoods have become less desirable environments in which to live, and rather than encouraging equal opportunity horizons through improved mobility for all citizens, the transport disadvantaged are still numerous.

From a conservationists and equity point of view, any moves which seek to provide a high level of transport service for everybody, at the same time minimising detrimental environmental (physical and social) side effects, at a cost which the community can afford, should be encouraged. The concept as outlined in this paper hopefully moves in that direction. However, seen just as a means of moving passengers, the demand responsive mini bus is unlikely to succeed except in special circumstances. It needs the dual function to maximise its operational efficiency and spread the costs more widely. Conceivably public transport as expounded here could even make a profit.

1.9 VEHICLE DESIGN CONSIDERATIONS

Within the urban context, there appears to be definite scope for a reconsideration of vehicle design to permit easy transition from passenger to parcel freight roles and vice versa. What is needed is the ability for rapid conversion from one role to the other at the transport depot. If the interior design is of some modular form, then the seating could be readily exchanged for an interior adapted for parcel delivery or even another specialised role. In discussions with the recently retired Chief Superintendent of Maintenance for New York's transit buses (N. Geller) I have been lead to believe that such conversion systems present little by way of technical engineering problems. Existing small buses could be adapted but ideally this should be incorporated at the factory and not as a later modification to the design.

Thinking modular, it is not so difficult to envisage larger vehicles being manufactured which can allow detachment of a bus passenger compartment to reveal a basic flat-top truck. This would help overcome the problem of

obsolescence in interior design and fittings for buses, as only a new module rather than a whole bus need be purchased in an updating programme

Whilst the question of the technical feasibility of dual purpose design may not appear to be difficult to solve satisfactorily, the question of costs is not so easy to determine. If only a few such vehicles are to be required, as say in an experimental situation, then costs could be high If on the other hand, numerous transport authorities around the world opted for such vehicles, then one could expect their unit cost to be little different from existing models. The question comes back to that of whether the public are likely to use such a transport system, and whether it is possible, organisationally and institutionally, to implement.

1.10 IMPLEMENTATION PROBLEMS

Just as with conventional bus systems, costs, labour relations and public attitudes will determine how well management can run the system and whether its form of operation is politically acceptable. Experience in most demand responsive bus systems in the 1970's has shown that operating costs cannot be recouped through the fare box any more than with many conventional bus systems endeavouring to provide a social service to dispersed low density suburban populations Some form of subsidy is required. Small bus operations can be even more labour intensive than corresponding large bus systems, which may be acceptable from a full employment point of view, but often unacceptable to those who deem that the user should pay the whole cost of the service.

It is arguable that the costs should be spread more widely than just to the user of public transport who all too often has no alternative anyway. The more people travel in public vehicles, the fewer the number of vehicles necessary to perform the total transport task and the less congestion faced by the remaining private motorists. Accordingly, the private motorist who stands to gain from others travelling by public transport should expect to bear some of the costs of providing that public transport.

1.11 LABOUR RELATIONS

The second major question as to whether the system as envisaged would work relates to possible labour attitudes. Labour unions have also become very specialised, and each naturally tends to look after the interests of its own membership It is debateable whether someone who considers himself a driver of a passenger bus will agree to drive the same vehicle in its alternative role, let alone have anything to do with handling parcels. This is an area of development in labour relations that would need to be thoroughly explored before a dual purpose scheme was introduced otherwise potential efficiences in manpower allocations could be negated and make the difference between having a high level service or none at all. The fact that mini bus systems are manpower intensive in the first place ensures that there would be many jobs still with the metropolitan transport authority or whoever ran the system. The move into the freight role as well could reduce the need for labour in many of the businesses which the public transport system would serve. This may well cause insoluable friction unless carefully negotiated and understood by the parties concerned.

It will be quite evident that the passenger aspect of the system outlined would act very much like a shared taxi somewhat larger than usual Taxi operators would doubtless see this as a threat to their existence for many riders would opt for the lower fare and forego the priviledge of sole occupancy. There will always remain a place for taxis in a metropolitan transport system. Rather than operating as an entirely separate and competing system, there would seem

advantages in association. Urgent calls for transport that cannot wait for the mini bus to satisfy would be passed on to the taxis. Taxis themselves could have their multiple hiring capability enhanced through access to the information coming into the operations centre. In essence taxi operations and demand bus operations should not be seen as mutually exclusive.

1.12 CONSUMER RESPONSE

The third problem area regarding the feasibility of the dual transport system, is that of consumer response. A methodology to assess potential ridership and use of the freight capability envisaged needs to be carefully thought through. A standard questionnaire approach in a sample survey could give very misleading results. It must be remembered that most of those being polled in any such survey will have had no experience whatsoever of this type of transport service in an urban area. Their responses are likely to be coloured by their experience of conventional bus systems which we know do not provide the levels of service to rival the private motorcar.

Previous surveys like those conducted by Bauer (1972) have shown that the service characteristics most sort after by potential users of demand responsive passenger bus systems are the certainty of arrival at a destination when planned, having a seat during the trip, and not having to transfer. Other characteristics sought after in public transport if it is to vie with the second or third family automobile, are minimal waiting time, low fares, longer service hours, and directness of routes.

No reasonably priced public transport system in the foreseeable future will be capable of meeting all these requirements. The system suggested in this paper will go some way to meet these desirable attributes. For many, it would be necessary to be seen to be believed. Short of mounting a full demonstration project, it is difficult to gauge potential consumer reaction in such circumstances.

One possibility is to make a film of simulated operations, ideally within the city or sector of a city in which it is proposed to introduce the service. Such a film can then be shown to community groups or at special meetings at which an informed spokesperson can answer questions about the services. Given a visual impression of how the *dual* demand responsive passenger and freight transport service might work, it is likely that potential customer reaction can be assessed with greater certainty.

1.13 COMPATABILITY WITH URBAN FORM AND ACTIVITY PATTERNS

The lessening of the traditional dominance of a single central business district in many large cities, and the concomitant rise in suburban retail and office nucleations, calls for compensating changes in public transport systems which traditionally have had a radial pattern focussed on the one central business district. As the circumference of cities have been pushed further out, so radial routes must continue to bifurcate to provide adequate geographical coverage. Service frequencies on the outer sectors inevitably cannot match the frequencies closer to the centre where more routes follow the same paths. At the outer extremities, fixed route bus services also tend to follow circuitous paths as they attempt to service dispersed populations in low density housing.

In such circumstances, the use of small demand responsive buses linking clearly defined outer suburban service areas to their regional business centre, would overcome some of the logistical problems of the traditional radial systems. Careful integration with express cross-town transit services would

provide public transport on a door to door basis more closely aligned with demand patterns Transfers would remain inevitable for travel beyond the local area, but need not take place at a multitude of bus stops. They could be confined to fewer interchange points offering a pleasing environment and ancillary services. As the urban boundary expands, so the new suburbs can be supplied with their local demand responsive bus. Growth can be accommodated relatively easily

Probably a more concrete Australian example needs to be discussed to illustrate the concept For this purpose I have taken the city I now live in, Canberra.

1.14 POSSIBLE CANBERRA APPLICATION

The developing town centre of Belconnen, in Canberra, now has 19 built-up residential suburbs and special landuses in two others The Belconnen town centre and the adjacent suburb of Bruce which contains the CCAE and a new hospital nearing completion provide the main institutional foci (Fig 1).

Until recently, all bus routes serving this sub-region of Canberra, ran from Civic and no interchanging took place in the Belconnen region itself The problem of long and circuitous routes, ever extending to incorporate the outer fringe developments was apparent. Now temporary interchanging at Higgins has been instituted in conjunction with increased frequency of services Ridership has increased contrary to the experience in some places where interchanging is regarded as a factor inhabiting ridership. Only the routes marked by solid lines in Fig 1 now run to and from the downtown Civic area The remaining routes are local connecting services.

In some respects, the recent changes in Canberra bus services and timetabling, especially in the Belconnen area, can be seen as a move in the direction of the type of service promoted in this paper. As the town centre develops to its full extent and the major bus interchange is built, it would be a simple evolutionary matter to have local suburb based mini buses focus either on the town centre itself in the case of adjacent suburbs, or on group centres as suggested in Fig 2.

These group centres and some lesser shopping precincts could be linked via a circular mainline bus route to permit travel between any pair of suburbs in the Belconnen region. Express bus services would run from the group centres via the main Belconnen town centre bus interchange to Civic or to other regional town centres such as Woden or Tuggeranong providing the necessary long distance services (Fig 2).

Natural groupings of suburbs exists around a group centre in the Belconnen region. For instance Macgregor, Latham, Holt, and Higgins focus around the Kippax centre Prior to the town centre itself being established, Aranda, Cook, Macquarie, Weetangera, Page, Hawker and Scullin, used the Jamison Centre in Macquarie, but the Belconnen town centre itself is better situated to become the group centroid for this cluster in the near future Charnwood, Fraser, Flynn, Melba, Spence and Evatt have no obvious common focus but could use the Melba shopping area. The newer developments in Giralang and Kaleen, as yet have no group centre and will not until the development of adjacent land

Without having conducted detailed assessment of requirements it would appear that in the peak hour period of demand, somewhere between 15-20 articulated buses could satisfy the major line haul requirements for group centre/town centre/Civic type or Woden movements on a 15 minute headway Six conventional buses should cope with the circular traffic, and approximately 35

EXISTING BUS ROUTES

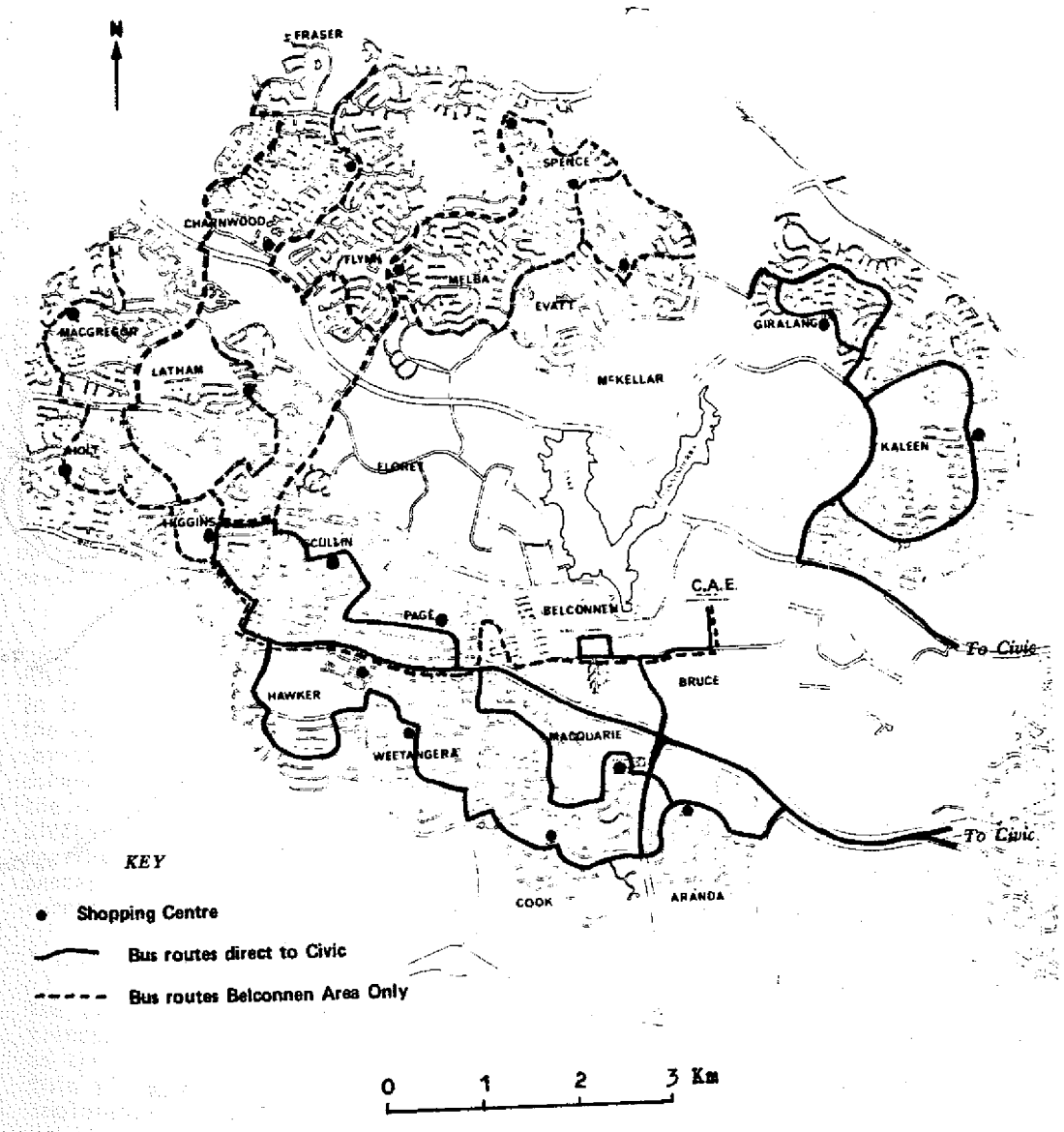

FIG I

THREE LEVEL BUS SYSTEM

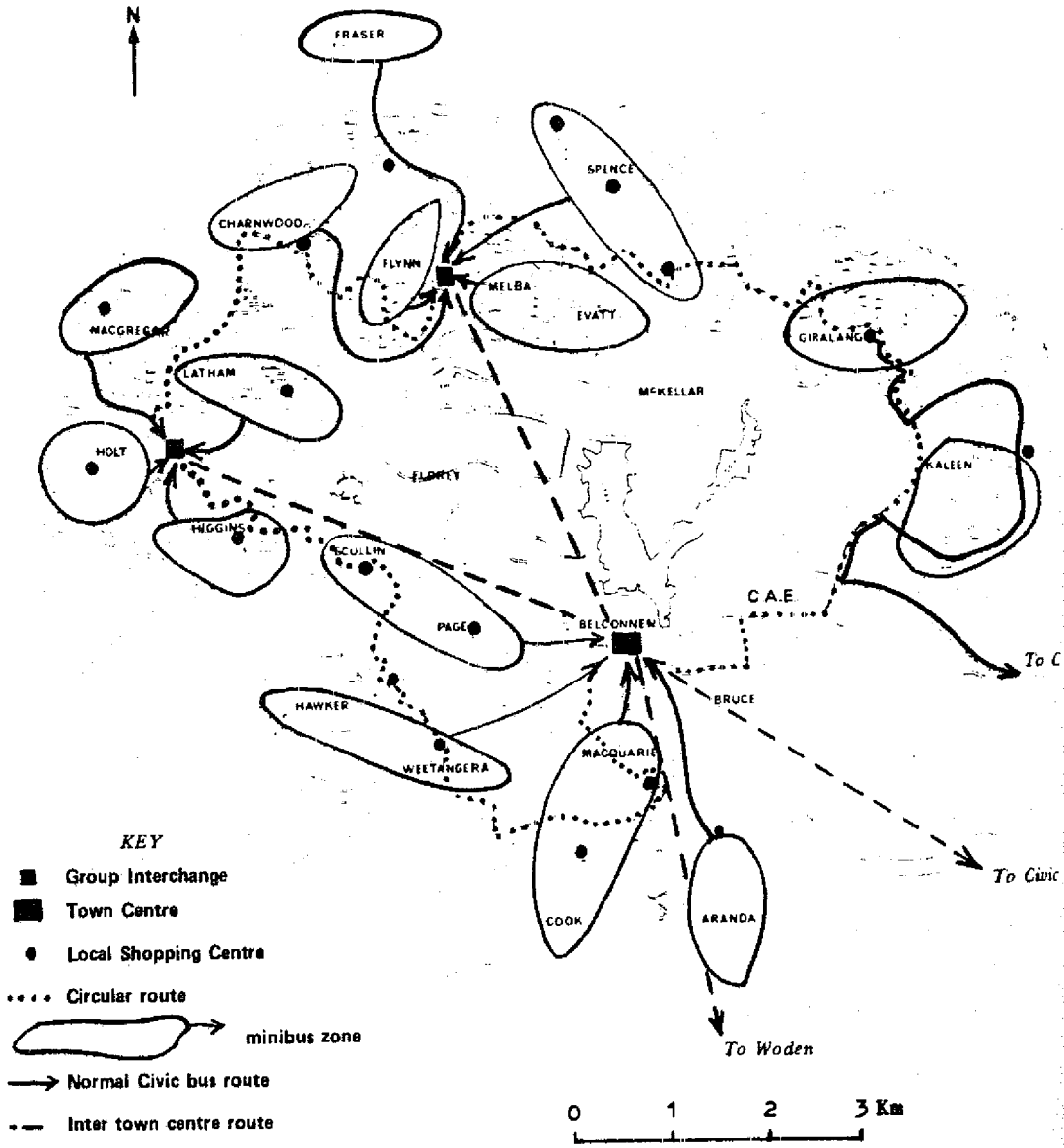

FIG II

mini buses would provide the local feeder requirements. Provided that the major line haul buses are given some priority by way of express bus lanes or preferential treatment at traffic signals, the line haul operations should be capable of very speedy express services.

An essential feature of this basically three level system (local, circular, and intertown) must be that intertown scheduled services should always connect with the local mini buses reducing time delays in the peak travel periods to a minimum. This will probably require local mini buses to operate fixed routes through their designated suburbs or zones with passengers permitted to hail the bus anywhere along the route. These fixed routes will not be confined to the wider thoroughfares in the suburbs, but may include narrower streets and so afford better coverage than is presently possible using larger conventional buses. Off-peak services may resume passenger loading or unloading at any address on a demand basis, but all mini buses working within their own zone and to a group centre, would continue to maintain coincident arrivals and departures at the group centre to permit easy transfer operations

Some added advantages of the three level system would be that a separate school bus service would no longer be necessary as pupils could ride the basic system to have access to any school, college, or educational institution in the entire Belconnen region. Also, in the weekends when access to sports fields is wanted, the same basic system will permit much superior point to point services than are presently available.

Whilst the planned suburban development of Canberra may seem to present an ideal pattern for mounting the type of services suggested in this paper, the features of suburban life, described are by no means unique to Canberra but are duplicated in all Capital Cities in Australia to some extent. Rail services may provide the main line-haul aspects, but the local suburban zone and regional needs are all too similar.

Once the peak journey to work period has passed, at least half the mini buses could be freed for "other duties" such as parcel delivery till the evening rush hour started. They could be assigned anywhere in the Metropolitan region. In the late evening probably only two mini buses per group centre could satisfy the demand as it arose, being particularly suited in their front gate type service to allay fears for personal safety after dark It could also act as a convenient after-meeting, after-party or pub 'get you home' service, reducing the necessity for individuals to drive their own vehicles after consuming alcoholic beverages. From the point of view of public image it would seem more desirable to operate the smaller buses in the evening hours with at least some passengers aboard rather than continue to use the larger conventional buses running virtually empty.

1.15 CONCLUSION

The idea of running an integrated demand responsive passenger and freight public transport service in urban areas as outlined in this paper should not be seen as the panacea to the urban transport problem. Other iniatives must parallel this if significant advances in levels of service are to be achieved. Any implementation of the dual role concept or replacement of conventional bus schedules with demand actuated ones cannot be expected to lead to any radical rethinking of the design and planning of modern suburbia in Australia In fact it is more a restructuring of the movement system to align it with existing land use patterns and transport needs In so doing, however, there is a definite attempt to co-ordinate two types of transport need in time and space in the interest of increased efficiency in both vehicle and manpower utilisation, and

in improved levels of service to potential customers. It is difficult to see how superior levels of public passenger service can be achieved, or existing levels maintained in many urban areas, without recourse to ever increasing subsidies or support from such dual purpose operations as suggested here. No new roadways or guideway facilities are required as sufficient capacity exists and the necessary technology is already 'off the shelf'. What is required is the organisational ability and institutional flexibility to make the concept a reality, and one which can grow and change as the city grows and changes

Few, if any existing public transport operators in Australia could be expected to experiment with the type of services discussed in this paper without fundamental support from government. What is needed is a detailed study into the feasibility of dual passenger-freight operations in urban areas. For this to be undertaken, government sponsorship seems inevitable This paper has outlined the concept. What is needed now is an in-depth evaluation.

REFERENCES

ALDERSON, S.R. (1968). Land Use Linkage Information as a Basis for Principles for Co-ordinated Land Use and Transportation Planning, in Barton Aschman and Associates Inc., *Guidelines for New Systems of Urban Transportation*. Vol. II, pp. 191-222.

BAUER, H.J. (1972). User Attitude Surveys and Transportation System Development. *Report No. 720176*. (Society of Automotive Engineers Conference: Detroit.)

GARRISON, W.L. (1969). Innovation of New Transportation Systems. *Defining Transportation Requirements*. Papers and Discussions of the 1969 Transportation Engineering Conference. (Washington, D.C. (1968).)

HALTON, C.C. (1976). Transport Planning. *Australian Transport*. October, p. 17-21.

MEYBURG, A.H. and STOPHER, P.R. (1974). A framework for the Analysis of Demand for Urban Goods Movements. *Transportation Record*. No. 496, pp 68-79.

PLATT, R.H. (1971). *Open Land in Urban Illinois*. (Northern Illinois University Press: De Kalb, Illinois.)

SMERK, G.M. (1972). The Urban Transportation Problem: A Policy Vacuum? in Miller, D.R. (ed.), *Urban Transportation Policy: New Perspectives*. (Lexington Books, D.C. Heath and Company.)