Driven around the bend

Melbourne's meandering bus routes

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PTUA

PUBLIC TRANSPORT USERS ASSOCIATION

Contents

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1 Introduction

Buses are a vital but underutilised component of Melbourne's public transport system and are generally the only means of public transport within regional cities. Only one third of Melbourne residents live within easy reach of a railway station or tram stop, leaving two thirds with a choice between buses, driving themselves or social isolation. While proposed rail extensions to Rowville, Doncaster and Mernda will bring enormous benefits to those areas, overall across Melbourne they will still leave most households beyond walking distance to the rail network. Meanwhile, fringe residential development continues with little indication of how these new communities will avoid costly and unhealthy car dependence (Sexton 2011; Thom 2011a; Perkins 2012a; Perkins 2012b).

Unfortunately slow and infrequent services, along with limited operating hours, mean that buses are currently not a genuine option for many people, leaving them with little choice but to own more cars per household, incur higher car operating costs and battle traffic congestion. For those who are unable to drive, these poor bus service levels can trap people at home and deny them education and employment opportunities (VCOSS 2010).

With each bus capable of carrying in excess of 50 people, bus services that are good enough to entice people out of their cars could help to cut congestion and pollution. On the other hand, bus services that fail to meet people's needs are resulting in more car traffic, worsening air quality and overflowing car parks (Thom 2011b).

Competent network planning by the newly-established *Public Transport Victoria* (PTV) could unlock much of the unrealised potential currently lost on Melbourne's meandering bus routes. Progress on creating a truly integrated multi-modal network that attracts a growing share of travel will be a key test of the government's commitment to PTV and to Melbourne's liveability.

Figure 1.1: Heavy car traffic

Lack of public transport that can compete with the car leads to heavy car traffic

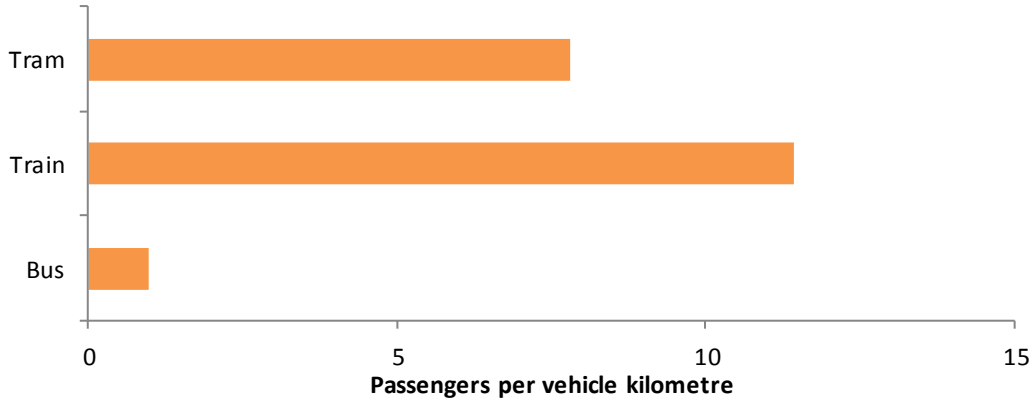
2 How do Melbourne's buses fare?

2.1 Compared to Melbourne's trains and trams

With a few notable exceptions (see section 5.1), bus services are failing woefully to meet the needs of Melburnians and residents of regional cities. Despite their more extensive coverage of Melbourne, with most Melburnians living closer to one or more bus routes than a train or tram line, only one kilometre is travelled on Melbourne's bus services for every six kilometres travelled on train services. Over four times as many passenger kilometres are travelled by tram than by bus, despite similar amounts of total vehicle kilometres and many trams and buses having comparable passenger carrying capacity. Trains and trams collect around 10 times more passengers than buses do for every kilometre the vehicle travels.

These comparisons show that buses are not living up to their potential to reduce traffic and ease pressure on car parking, particularly in areas with poor access to rail services.

Figure 2.1: Passengers per vehicle kilometre by mode - Melbourne



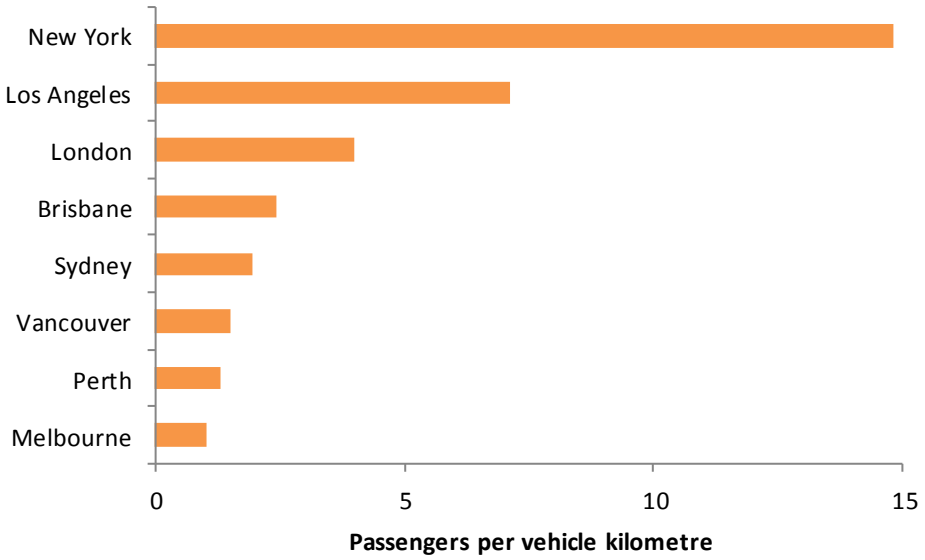
Source: Victorian State Budget 2012-13

2.2 Compared to buses in other cities

Melbourne's buses also compare poorly against interstate services. About twice as many passengers board Sydney's buses for every kilometre travelled, while nearly two and a half times as many passengers board Brisbane buses per kilometre (BITRE 2009).

As rivals for the world's most liveable city status, Melbourne is often compared to Vancouver. Vancouver's buses collect around 50% more passengers per vehicle kilometre than Melbourne's buses (Ashley *et al* 2006). While Los Angeles is widely regarded as the epitome of car dominance, its buses collect around the same number of passengers per kilometre as Melbourne's trams, or close to seven times as many passengers as Melbourne's buses (Ashley *et al* 2006). One must look to the likes of provincial cities such as Geelong to find bus services that attract fewer passengers than Melbourne's.

Figure 2.2: Passengers per bus vehicle kilometre by city



Vancouver, London, Los Angeles and New York figures are passengers per kilometre from Ashley et al 2006
Melbourne, Perth, Sydney and Brisbane figures are passenger boardings per kilometre from BTRE 2009

3 Good practice

Patronage in the range of two to four passengers per vehicle kilometre is quoted as desirable for buses (Ashley *et al* 2006; Mistretta *et al* 2009). With patronage only reaching about half of the lower end of this range, Melbourne's bus services clearly fall well short of best practice.

The following attributes, denoted by the acronym 'SCARCE' (Gray 1992), are frequently cited as key success factors for public transport:

- Safety
- Comfort
- Accessibility
- Reliability
- Cost
- Efficiency

The performance of Melbourne's public transport on these criteria has been assessed previously and the results were disappointing (Booz & Co 2008; PTUA 2009, pp.1-12). For example, integration between services remains poor and frequencies inadequate to offer a genuine alternative to private cars (PTUA 2010; Parker 2011). Rather than dwelling on these recognised deficiencies, this report will take a more targeted approach to assessing Melbourne's bus routes.

Best practice in network design is characterised by simple (i.e. easy to understand) and direct routes that intersect with other routes to offer connections to the desired destination (if that destination is not served by the first route). To minimise waiting for connecting services, services should be frequent and/or closely coordinated (Nielsen *et al* 2005; Mees 2010; Mees & Dodson 2011, pp.2-5). In an environment like Melbourne's where services are delivered by private operators, competent and effective central planning is necessary to ensure that individual route operators do not undermine the effectiveness and integration of the broader network as they seek to maximise commercial benefits for themselves (Mees 2010).

A report on best practice bus systems prepared for the Victorian government highlighted three major elements for success (Booz Allen Hamilton 2002):

1. **Strong Centralised Planning and Patronage Risk Taking** – in all cases planning was undertaken centrally by Government authorities. None of the examples involved private sector planning of services but in most cases private operators were responsible for running services on behalf of Government.
2. **Centralised Branding/ New Image Promotion/ Re-Inventing Buses** – In most cases a new type of bus concept was promoted in a coordinated manner to change prevailing views regarding the services offered.
3. **High Levels of Investment and Service Level Increases** – All examples involved investment in new services. In general, the returns in terms of patronage growth were greater when investment was larger.

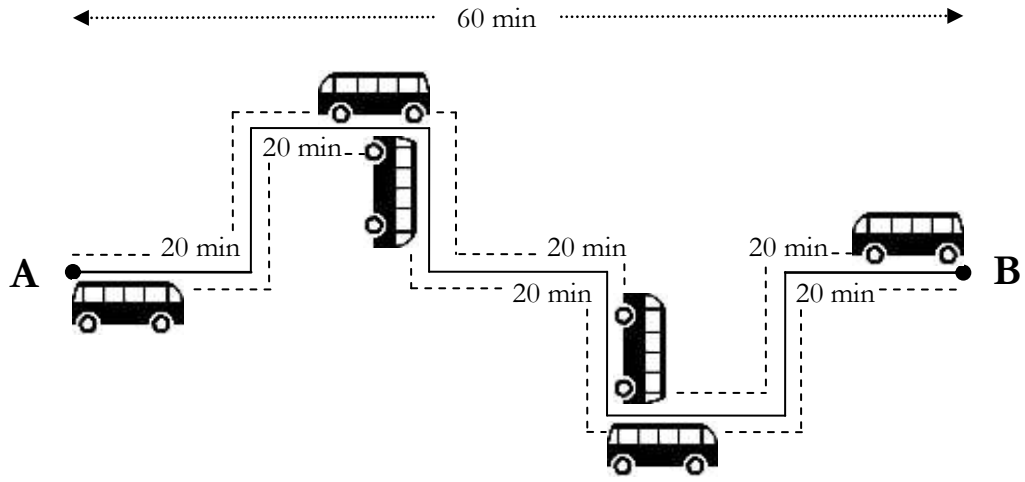
3.1 Directness saves time and money

There are three main factors affecting the cost of operating bus services:

- **Peak vehicle requirement** - the number of buses needed to provide services at times of highest service levels (typically peak hours). Even when not operating, these vehicles still incur costs such as financing, insurance and storage/garaging facilities. For example, the capital financing cost of each bus can amount to around $60,000 per annum.
- **Operating hours** - costs such as driver wages are most closely related to the amount of time a bus is operated, rather than how far it is driven. These are often the most significant components of total operating costs (Walker 2011).
- **Vehicle kilometres** - costs such as fuel tend to increase in line with vehicle kilometres.

Meandering bus routes that entail lengthier journeys and longer travel times therefore cost more to operate and require larger outlays on bus fleets. This limits service levels to a low standard that is unattractive to people with the option of driving.

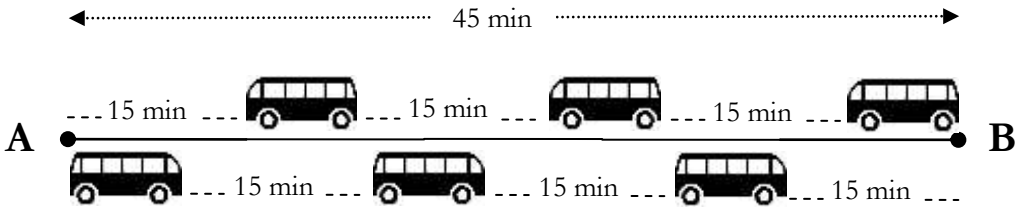
Figure 3.1: Route 1 - an indirect route



If a route takes two hours for each bus to do a return trip, and services operate every 20 minutes, then six buses (and drivers) will be needed to operate this route. That is, three buses will be travelling in each direction, with each separated by 20 minutes.

When route directness is improved, more services can be provided with the same number of vehicles, operating hours and vehicle kilometres. In other words, more frequent services, offering faster journeys can be provided for the same cost. On the other hand, diversions from the optimal route increase the amount of time each bus needs to complete each trip, so more buses are needed to provide the same number of services, and operating costs increase accordingly.

Figure 3.2: Route 2 - a direct route



If the time required to travel each direction of the above route was shortened to 45 minutes, the same number of buses (and drivers) could provide services every 15 minutes.

There are two main ways to shorten route cycle time:

i. make routes direct; and
ii. increase average speed using priority measures that reduce delays, such as head-start lanes and B-lights at intersections and bus lanes along the route (Nielsen *et al* 2005, pp.128-132).

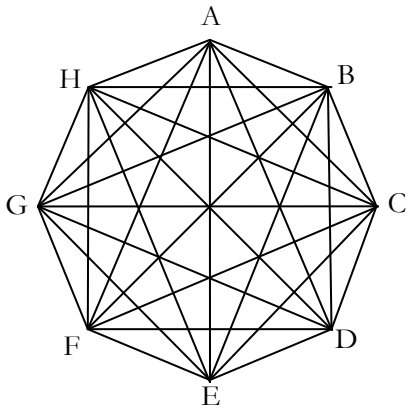
Figure 3.3: Buses parked at the depot when not in use

Large numbers of buses – needed for peak service levels – can sit idle when service levels are reduced, such as on weekends.

3.2 An integrated network - not 'all routes must go absolutely everywhere'

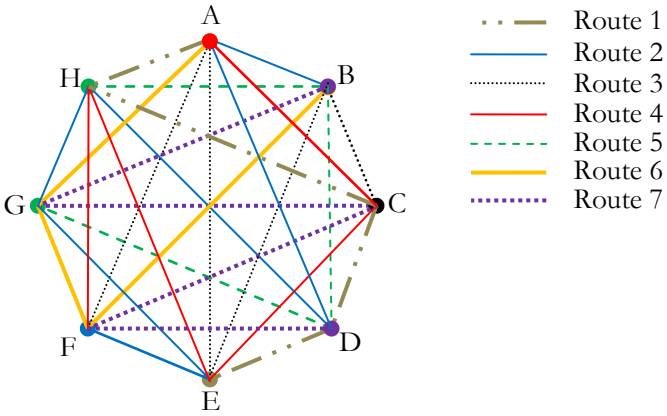
Network design that attempts to avoid transfers can lead to very inefficient route structures, with either a large number of separate routes or a smaller number of meandering routes trying to serve multiple destinations. Since the number of buses that can be provided is limited, the result is services that are infrequent and slow for most trips. So slow that potential passengers resort to their cars and overflowing car parks.

Figure 3.4: A non-network - separate routes to everywhere



Providing separate routes between each of these eight destinations so that no trip involves a transfer to a connecting service requires 28 separate routes. If each route takes ½ hour in each direction, 28 buses would be needed to provide hourly services. Journey times would average one hour, comprising the ½ hour travel time plus an average ½ hour wait for the hourly services. Waiting time may be reduced by building your daily schedule around bus timetables, however most people with access to a car would opt instead for the relative convenience of driving, as shown by transport mode share across much of Melbourne where only infrequent buses are offered. Whether or not passengers studiously consult timetables, journey times would still be blown out massively by service cancellations given the one hour wait until the following service.

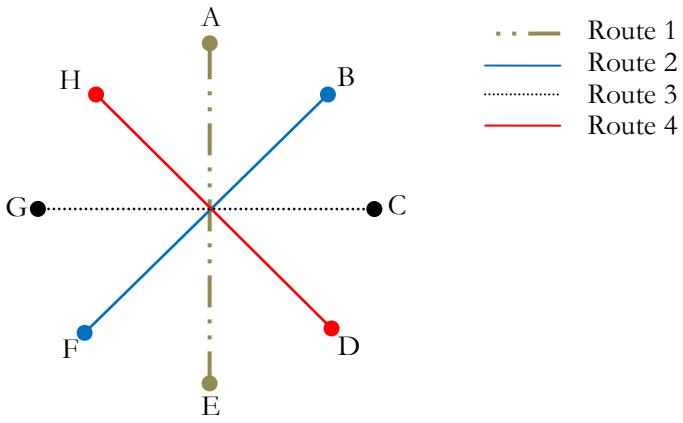
Figure 3.5: Another non-network - ad-hoc linking of routes



The number of separate routes could be reduced by joining routes together, however the lengthened routes would be very indirect, and no more frequent unless additional buses and drivers were provided. The resulting network is likely to be confusing, or not 'legible', which would also deter potential passengers. This approach has been common in Melbourne in the past (Mees 2000, p.238).

Running a smaller number of more frequent routes can still provide access to the same destinations and can even result in faster journeys, as long as the network is well-planned and integrated (Walker 2009). In other words, a frequent, well-integrated network can offer services every 10 minutes to everywhere, while a jumble of infrequent routes is useless to most people.

Figure 3.6: An integrated network of frequent services

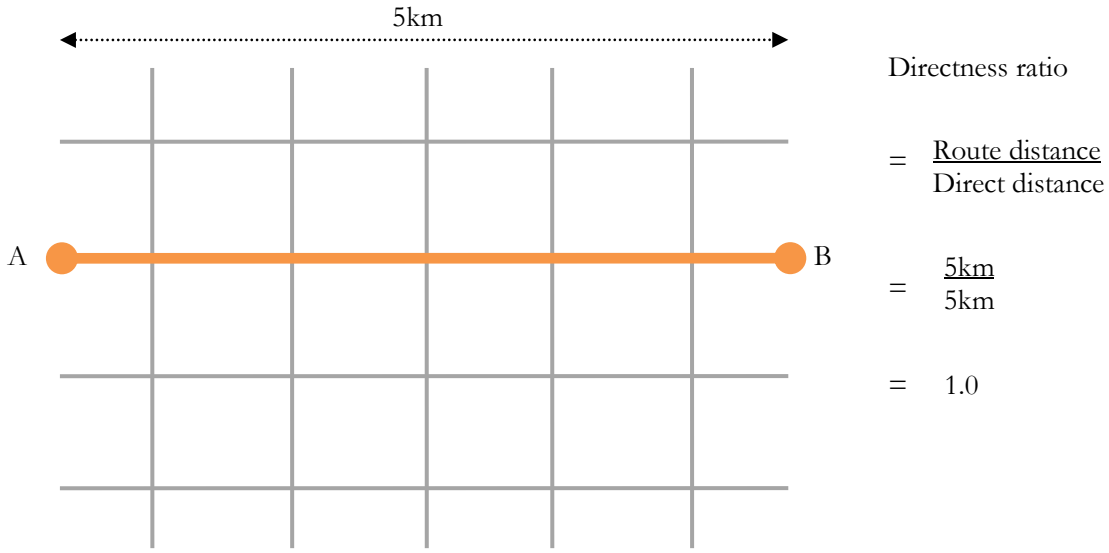


Distributing 28 buses equally between four intersecting routes would enable buses to operate about every 10 minutes, given one hour return trips. On average, journeys requiring a transfer would comprise an average five minutes wait for the first bus, 15 minutes travel to the interchange point, 5 minutes waiting for the connecting service, and 15 minutes travel to the destination, or 40 minutes in total (20 minutes less than the previous example). Some journeys would still not require a transfer, and would only take 35 minutes including waiting time - about half the journey time in the previous example. Due to the close proximity of following services, journey times would not be affected as much by cancellations. The network is simple and therefore more legible to people not familiar with the system.

3.3 Measuring directness

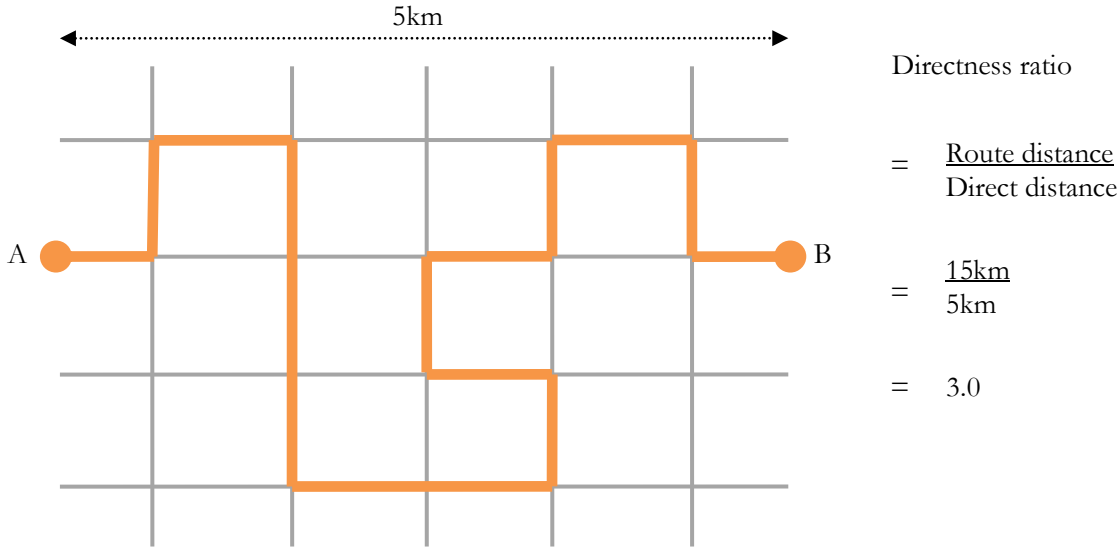
Route directness can be measured by calculating the ratio of the actual route distance over the direct distance between the start and end points. Like a golf score, a lower number is preferable, with the best possible score for any given hole (or route) being one.

Figure 3.7: Route 1 - a direct route



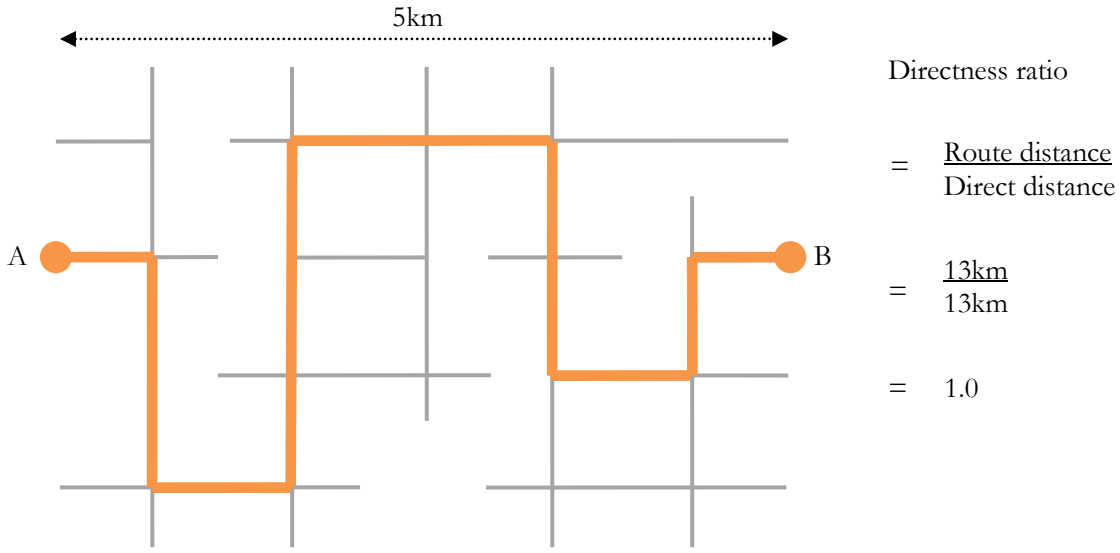
Route 1 runs in a straight line from A to B. At an average speed of 25 km/h, trips take 12 minutes each way, allowing each bus to provide up to five one-way services per hour.

Figure 3.8: Route 2 - an indirect route



Route 2 takes an indirect route from A to B, travelling a total of 15 kilometres each way. At an average speed of 25 km/h, trips take 36 minutes each way, preventing each bus from providing any more than one complete one-way service per hour.

Figure 3.9: Route 3 - poor urban planning



Route 3 is forced to take what appears to be an indirect route from A to B, however it is the most direct route available due to poor street layout. At an average speed of 25 km/h, buses take just over half an hour to travel the 13 kilometres each way, preventing each bus from providing any more than one complete one-way service per hour.

Figure 3.9 highlights the importance of good urban planning. Although the Department of Transport, and more recently Public Transport Victoria, has referral powers under the *Planning and Environment Act 1987*, it is not clear that good practice urban design is being enforced effectively in new developments (Perkins 2012a; Perkins 2012b).

3.4 Best practice

Directness ratios of between 1.1 and 1.3 are suggested for most bus routes (Ampt *et al* 1990, p.354; Ministry of Transport 2006, p.20; Mistretta *et al* 2009), although higher ratios may be acceptable for shuttles and community buses which, in Melbourne, are typically operated by council and non-profit community transport services (see table).

Table 3-1: Example Route Directness Ratio Guidelines

Service Type	Ratio
BASE and Viva	1.0 to 1.1
Local	1.0 to 1.2
Express - fixed route	Equal to or less than the underlying route. 1.0 within the express or limited stop portion of the route.
Express – business	1.0 outside of any local service area. Local service areas should be limited to 5 stops or less.
Shuttle	1.25 to 1.75
Community bus	Less than 2.5, Less than 2.0 for Local Routes in small communities

Source: Mistretta et al 2009, p.65

4 Bus route report cards

4.1 Melbourne's buses: "easily distracted, could do better"

While some bus routes meet the directness benchmarks above, meandering routes seem to be the norm, highlighting a key factor in Melbourne's under-performance relative to other cities. The average directness ratio for Melbourne bus routes is 1.7, the majority of routes have ratios above 1.3, 20% are over 2.0 and around 10% have ratios above 2.5. By comparison, the averages for Melbourne's substantially more popular train and tram lines are both about 1.2.

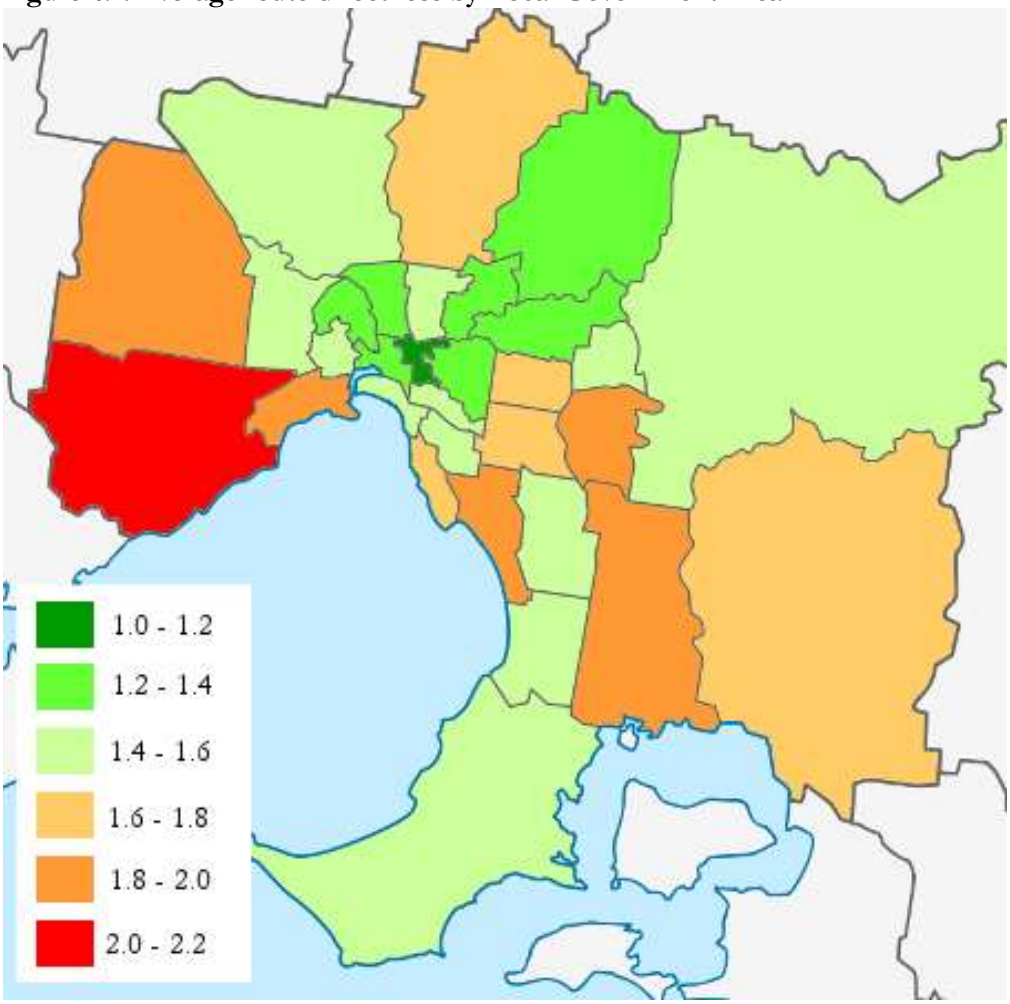
Table 4-1: Route directness by Local Government Area

Council	Average directness	Proportion of routes above: *1.3*	*2*	*2.5*
Banyule	1.4	36%	12%	4%
Bayside	1.6	56%	6%	6%
Boroondara	1.4	38%	8%	0%
Brimbank	1.5	68%	20%	0%
Cardinia	1.6	55%	18%	18%
Casey	1.9	69%	25%	19%
Dandenong	1.6	62%	14%	10%
Darebin	1.5	46%	23%	12%
Frankston	1.5	58%	13%	4%
Glen Eira	1.4	52%	10%	0%
Hobsons Bay	2.0	71%	36%	14%
Hume	1.6	63%	19%	4%
Kingston	1.8	64%	16%	12%
Knox	1.8	62%	19%	14%
Manningham	1.4	39%	13%	0%
Maribyrnong	1.5	38%	14%	5%
Maroondah	1.6	50%	25%	15%
Melbourne	1.2	23%	5%	3%
Melton	1.8	62%	23%	15%
Monash	1.6	54%	14%	6%
Moonee Valley	1.4	38%	13%	4%
Moreland	1.3	33%	10%	0%
Mornington Peninsula	1.5	50%	20%	0%
Nillumbik	1.3	36%	9%	0%
Port Phillip	1.5	47%	13%	7%
Stonnington	1.4	58%	11%	0%
Whitehorse	1.6	53%	18%	6%
Whittlesea	1.6	67%	11%	11%
Wyndham	2.1	83%	39%	17%
Yarra	1.2	19%	4%	0%
Yarra Ranges	1.6	48%	28%	16%
Greater Melbourne	**1.7**	**57%**	**20%**	**10%**
Yarra Trams[1]	*1.2*	*14%*	*3%*	*3%*
Metro Trains[2]	*1.2*	*22%*	*0%*	*0%*

[1] The only tram route above 2.0 is route 72 which the PTUA believes should be split into two separate routes, including a north-south route extending to Caulfield station to the south and to Doncaster Road, the Eastern Freeway and ultimately Ivanhoe railway station to the north.

[2] Calculated as ratio of actual route distance over straight line 'as the crow flies' distance (instead of most direct road route), resulting in higher ratios, especially for the Williamstown line.

Figure 4.1: Average route directness by Local Government Area



Many bus routes in Melbourne and regional cities are so indirect and incomprehensible that some people call them "wandering minstrels". For example, some bus services travel over 10 kilometres to reach a destination only two kilometres away (see Figure 4.2). The resulting bus journeys are so slow that most people with the option of driving will avoid the bus. The complexity of numerous, meandering, overlapping bus routes also harms 'legibility' and deters potential passengers who are unfamiliar with the network. These factors can lead to the perverse situation of heavy single-occupant car traffic at the same time as half empty bus services.

There is enormous potential for the existing bus fleet to carry more people, getting more cars off the road and relieving railway station car parks. This can be done through measures such straightening out bus routes, and though giving buses priority along the route, so that bus services get from A to B faster. The time savings would allow each bus to travel between A and B more often, offering more frequent services, which would in turn increase the effective capacity of the bus fleet and shorten waiting times for connecting services. This would entice more people out of their cars and help to relieve traffic and parking pressures.

While bus routes in Melbourne and regional cities have been subject to some systematic reviews in recent years, very few of the review recommendations have been implemented (Lucas 2010). Many of the recommendations would allow more frequent services along more direct routes that could save time for existing passengers and make the services more usable for potential passengers who are currently put off by slow journey times.

Table 4-2: Average route directness ratios for selected bus service reviews

Review area	Average route directness	
	Existing	Recommended
Bayside/Kingston/Boroondara	1.6	1.4
Banyule/Darebin/Moreland/Melbourne/Port Phillip/Yarra	1.5	1.3
Banyule/Nillumbik	1.5	1.3
Knox/Maroondah/Yarra Ranges	1.7	1.5
Whittlesea	1.6	1.4

Source: Metropolitan Bus Service Reviews (various)

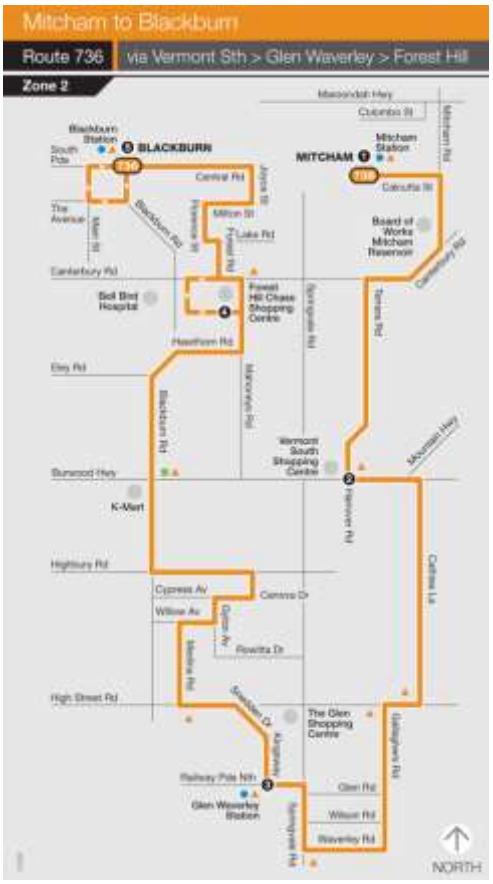
The failure to implement more of the bus review recommendations was just one of the many symptoms of poor transport planning in Victoria that prompted the establishment of a new public transport authority known as *Public Transport Victoria* (PTV). Many bus routes are based on routes designed long ago by private operators keen to poach passengers from - rather than deliver passengers to - train and tram services (Mees 2000). A focus on contract management since privatisation, rather than integrated network planning, had done little to create a more versatile network capable of meeting diverse travel needs.

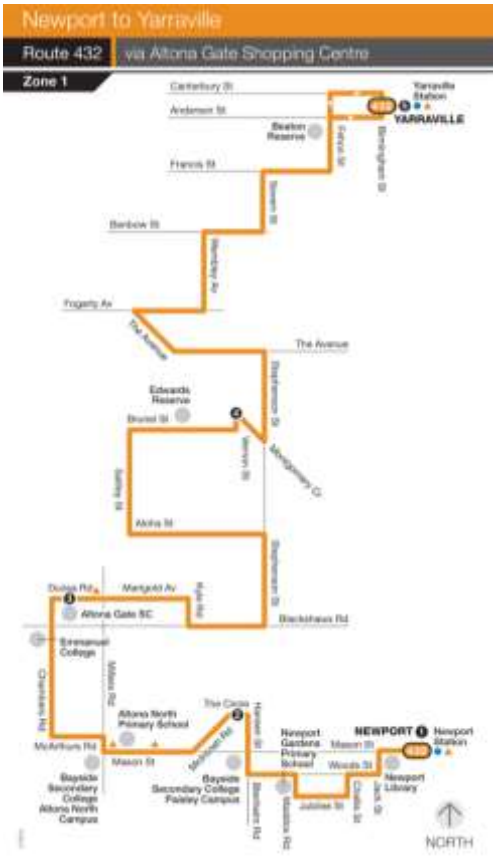
Bus service operators are vital stakeholders, and many made valuable contributions to the bus service reviews. However, it must be remembered that payments to operators are based on bus operating hours and service kilometres, both of which are higher for indirect routes (see section 3.1). Therefore operators have a clear commercial incentive to propose routes that are not as direct as they could be. Operators may also have an incentive to poach passengers from other public transport services, even if this undermines the network, particularly if contracts include payments based on patronage.

To ensure the public transport network works for passengers making diverse journeys, and for taxpayers seeking value for money, strong and competent central planning of the network is necessary. No successful system leaves network planning in the hands of private operators (Booz Allen Hamilton 2002).

A key test of the new authority will be PTV's success (or otherwise) in implementing bus route reforms that contribute positively to the "SCARCE" success factors listed above (see section 3). Failure to create a legible and tightly integrated multi-modal network of fast and frequent services will be strong evidence that PTV has not yet been given the right people with the right skills and sufficient authority to deliver a successful public transport system.

Figure 4.2: Some of Melbourne's "scenic" bus routes





Source: Public Transport Victoria

4.2 Regional city bus routes: making Melbourne look good

For many years, Victorian state governments have promoted regional Victoria as a desirable place to live. Yet Victoria's largest regional cities are extremely car dependent.

Buses are the only public transport option in these cities, but the indirectness of many routes, coupled with infrequent services, means that they do not provide a usable alternative to the car. This has a highly negative effect on sustainability, liveability and local amenity.

Typical bus routes in Ballarat, Bendigo and Geelong manage to make even Melbourne's meandering bus routes look direct and well-integrated (see Table 4-3). Against the relative convenience of the car, it is little wonder that public transport is failing to attract a larger share of journeys within our regional cities.

Table 4-3: Route directness for Victoria's largest regional cities

City	Average directness	Proportion of routes above: *1.3*	*2*	*2.5*
Ballarat	1.8	74%	26%	11%
Bendigo	2.1	73%	40%	13%
Geelong	1.6	76%	19%	5%

Figure 4.3: Regional routes - loops and back-tracks

Source: Public Transport Victoria

5 Realising the potential

5.1 Glimmers of hope

Melbourne's SmartBus services provide a glimpse of what is possible in Melbourne. SmartBus routes are much more direct than many other Melbourne bus routes, with directness ratios for non-orbital[3] SmartBus routes in the range of 1.0 to 1.2 compared to the Melbourne bus average of 1.7. This allows service kilometres to be invested in service frequencies that meet user needs rather than meandering - infrequently - along longer, slower, indirect routes.

SmartBus services attract over 50% more passengers per vehicle kilometre than other Melbourne bus services, with higher frequencies being a key attraction (Currie & Delbosc 2010) as predicted in the analysis mentioned in section 3 above (PTUA 2009, pp.6-7).

The frequent and direct routes 401 and 601 have also proven popular with passengers transferring to and from rail services at North Melbourne and Huntingdale railway stations respectively. These two routes alone account for a significant slice of bus patronage growth in Melbourne.

5.2 Route map for reform

Reforming Melbourne bus routes to bring the average directness ratio down from 1.7 to 1.4 would enable between 15-20% more services with the same number of buses, thereby allowing frequencies to be increased and waiting times to be cut. Simultaneously introducing bus priority measures to increase average speeds, together with additional resources where required, would enable even more significant frequency improvements that are consistent with good practice public transport networks.

This would make buses a more attractive option for many people who currently drive, and help to ease pressure on roads and car parking across Melbourne.

As with transport planning in general, genuine public consultation will be vital to ensure successful implementation. The lack of meaningful engagement with the public on transport planning was another key motivation underlying demands for the establishment of an independent public transport authority (PTUA 2011, pp.3-5). There must now be a substantial investment in the capability of local communities to make fully informed decisions about the merits of different options, and then a commitment to ensure the implementation remains true to the goals articulated by the community, as done in best-practice cities (Ministry of Transport 2006, pp.12-13; PTUA 2011, pp.3-5).

> "**Residents of cities must be involved in decisions**, at a metropolitan and at a local level. In our sample, such involvement appears to have been critical to making tough decisions that were then actually implemented. This level of engagement is an order of magnitude different from what happens in Australia today." (Kelly 2010, p.45)

The big question now is - will the government give *Public Transport Victoria* what it needs to make it happen?

[3] Orbital routes are not intended for journeys along the entire route, so the end-to-end directness ratio is not applicable. Despite this, orbital SmartBus directness ratios are not out of the ordinary for Melbourne bus routes.

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