Island Platforms, Terminus Loops and Unidirectional Trams: An Analysis of the Evidence

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This article examines existing literature and opinion on the following specific tram operational issues:

- Easy-access passenger platforms in multi-lane roads – central island or side island?
- Terminus loops - balloon loops or around-the-block loops?
- Unidirectional vs bidirectional running?

The context of this analysis is my consideration of design for a Sydney light rail system in my recent TA article (Prescott 2008), in the course of which I found a frustrating lack of critical discussion of these basic design and operational issues. Most studies often completely ignore them and make bold, but sometimes short-sighted, assumptions concerning light rail operation and infrastructure, assumptions that then translate into decisions. Dead-end termini and bi-directional trams are the inevitable default in new Australian systems, while centre-island platforms are often chosen (e.g. in Adelaide) for initial cost-saving and road-space reasons; both illusory factors as will be shown.

Platforms on narrow roads (four lanes or less) are not considered in this analysis as they are generally, of necessity, on the nearside (kerb side) of the tram.

Platforms

Unidirectional trams with doors on the nearside of the tram necessitate platforms being located on the nearside. Bidirectional trams have doors on both sides and thus can be operated from either nearside (side-island) or central island platforms.

Older tram systems around the world tend to have nearside access/platforms but new systems, such as the Adelaide extension and the Luas system in Dublin, have assumed bidirectional operation in perpetuity and make liberal use of central island platforms. On the other hand, the specification for the Gold Coast light rail system stipulates side platforms emphatically and without apparent debate! (TransLink 2008.) One wonders about the presumptions made and the amount of analysis given to this issue in designing these new systems.

An electronic literature search reveals one substantial paper that deals (in part) with the merits of central island vs side island platforms. This was written by Dennis Cliche (Chief Executive of Melbourne's Yarra Trams) and Sam Reid (Cliche and Reid 2007). The authors note that platform stops have produced a number of improvements in the Melbourne tram operation:

- level access for mobility-impaired passengers (and thus compliance with the Disability Discrimination Act);
- reduced dwell times; and
- improved public amenity through safety, lighting, shelter and real-time passenger information systems.

Melbourne has a bidirectional tram operation and thus is able to place platforms on either side of the tram. The authors note that, currently, Melbourne has a motor traffic-influenced preference for central island platforms because it is believed that they occupy less road space and thus reduce the impact on motor traffic flow. But how does this stand up to analysis?

The amount of additional road space made available, according to the authors, is 0.5 metre on each side of the tram tracks; one metre in total. This is not enough to provide an additional traffic lane but can, according to the authors, allow for insertion of bike lanes. However even one metre is actually below accepted standards for one bike lane,

To illustrate this feature on platforms, TA is simply going to use some Alan Wickens photographs of Melbourne platforms, and trams, taken during a visit from New Zealand in March. This first photograph is at Peel Street outside the Queen Victoria Market on 19 March and shows Z3 185. Note that the platform alongside the tram appears to be fairly narrow and might present a challenge to a wheelchair user and a pedestrian trying to pass each other.


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let alone two. Ausroads recommends an absolute minimum standard of 1.2 metres for a bike lane on a low-speed road (NSW RTA 2005) so the authors' suggestion does not appear legally or practically possible.

On the other hand, the authors note some disadvantages of central island platforms, including:

- that they are more expensive to build (for an existing system) because they involve splitting and slewing the tram tracks and overhead wires; and
- trams have to be fitted at some considerable cost with an automatic mechanism and software to override the driver to ensure that the doors are opened on the platform side of the tram, thus avoiding the possibility of the driver accidentally releasing passengers into traffic flow on the nearside of the tram.

The latter point of disquiet seems to suggest that the first fatal systemic failure of such operational practice will lead to a flurry of expenditure on fencing between the nearside of the track and the road lane as a further failsafe! These failures have already occurred, as evidenced, for example, by alarming passenger reports of wrong-side door incidents in Adelaide and on the Dublin Luas (see for example 'Commuting & Transport: Luas doors' at www.boards.ie). Concerns include children and absent-minded adults bolting out the door into traffic and a crush of commuters leaning against a door falling out of it when it opens unexpectedly.

It can be added that one metre of additional road space translates into one metre less of total platform width available to tram users, this on top of conflicting movements on a shared platform servicing counter-directional flows.

On this evidence at least, it is difficult not to conclude that central island platforms offer no advantage over side-island platforms and indeed have some significant cost and safety disadvantages. The 'advantage' of one metre of total additional width in the motor vehicle carriageway cannot be put to any use. If a traffic lane is lost to a side-island platform, it cannot be recovered by use of a central island platform. The only possibility for accomplishing this is to have offset side-island platforms and slew the tracks around them (together with some footpath resumption) as shown in the Hong Kong example in my 2008 TA article. Considering that Australian tramway systems have traditionally used nearside loading, one wonders if central island platforms are not something being thoughtlessly forced on systems by road authorities intent on minimising the loss of road space for motor vehicles, notwithstanding the lack of any practical outcome to that end!

Terminus Loops

Literature searches have not revealed anything of substance on this subject other than the well-established generic knowledge that a loop can expedite the turnaround of a train or tram at a terminus because the vehicle does not have to reverse direction and the driver does not have to take the time to change to the opposite-end driving position and go through the procedures necessary to reverse direction.

The author has timed the turnaround of a Sydney MLR tram at the single-road Lilyfield terminus at about 2.5 minutes. Unlike many train systems this is done at the platform so that passengers can disembark and embark during the time it takes for the driver to change ends. So this would be close to the optimal time it can take to turn a tram around on a single terminus road. Under close headways, the operation can of course be expedited by the use of two or more terminus roads or driver relays. The very busy former Sydney tramway system had terminus loops at all city termini and busy suburban termini, particularly in the eastern suburbs. The

LEFT:
The standard side island Melbourne platforms at Albert Street in Nicholson Street on the same day as photographed by Alan Wickens with D1 5010 passing City Circle W7 1010.

RIGHT:
Again on 19 March Alan Wickens photographed A 275 at Docklands Park on Route 70. Here the platforms are staggered instead of opposite each other and there seems to be no sign of any shelters. Those who have not visited Melbourne for some time will probably be surprised at the Docklands development which has helped drive the 40% increase in City employment which, in turn, has applied much pressure to peak hour transport in Melbourne.

exception (for busy routes) was the three-road terminus at North Bondi that replaced an earlier loop at Bondi Beach.

The Gold Coast Rapid Transport specification nominates a turnaround time of 2 minutes (including having the driver check the vehicle!) and 3 minute peak headways, which suggests that they would definitely require loop termini, but there is no discussion of this in their analysis (TransLink 2008). Their stipulation of side-island platforms may indeed have some unexpected wisdom!

There is no doubt that a loop terminus (or a looped route) is an advantage, if not essential, for very busy, high frequency tram routes. Additional dead-end terminus roads and driver relays can, however, provide significant additional capacity before reaching the need for a loop.

Unidirectional vs Bidirectional Running

Unidirectional trams require loop termini and, where applicable, intermediate loops for short-workings along a route. In my paper on Sydney light rail I stated the following advantages of unidirectional trams (Prescott 2008):

- the cost of the rolling stock will be less as only one driver's cab and full set of controls has to be provided, as well as doors on one side of the vehicle only;
- there will thus be more passenger accommodation (seats and standing) in each car and most seating will face forwards.

This has been confirmed in discussion with a major European manufacturer of unidirectional trams, Skoda Transportation (Prescott 2009). Their advice is that operators chose unidirectional operation on the basis of the above advantages and their ability to incorporate loops in their track planning.

The commonly perceived disadvantage of unidirectional trams (other than not being able to fit loops into the system) is the problem of reversing direction in the event of a temporary or sudden short-working (e.g. track maintenance or an accident). However, Skoda advises that unidirectional trams are fitted with basic controls for operation in a reverse direction. (Like a bi-directional tram they can of course operate at the same acceleration and speed in reverse as they can in a forward direction.) In some larger systems, such as Prague, a small fleet of bidirectional trams is available that, apart from being used in normal operations, can be used where lines are temporarily truncated for trackwork. In smaller cities, unidirectional trams can be coupled back-to-back in such circumstances, with only the first car being used for passengers.

The author has found no substantive argument against unidirectional trams in literature searches. The Perth Light Rail Study (Maunsell Australia 2007) is rare in that it specifically addresses "single-ended" (unidirectional) operation and notes the same advantages I have given above (cost and passenger capacity/facilities) and the following 'constraints':

- platforms must be on nearside of tram so central island platforms are not possible;
- loops must be provided and if they are around a block they can have tight curves and associated noise and wheel wear; and
- depot design is more complicated as vehicles must be able to leave cab first.

There is, however, no critical analysis of these reasons and the study abruptly concludes that double-ended (bidirectional) operation is best for Perth.

In fact, these reasons do not stand up to scrutiny. The counter-arguments are:

- As discussed above, central island platforms appear to have significantly more disadvantages than advantages; thus side platforms may actually be better anyway. In addition, unidirectional trams are immune from wrong-side door incidents so do not incur the additional cost of failsafe systems and fencing at platforms.
- Loops can be designed to have the appropriate radius for the chosen vehicles and, if pivoting-bogie low-floor vehicles are selected, the radius of the loops (or corners if "around-the-block") can be quite tight without undue track wear and noise. (The system may be operating around street corners in any case along its routes so the same objection could just as well apply there!)
- Depot design is **exactly the same** as for bi-directional trams; unidirectional trams simply reverse into the depot (using

their rear controls if necessary) rather than going in "forward". A triangular switching arrangement at the entrance to the depot yard (often available anyway in depots for bidirectional systems) is all that is required.

In conclusion, unidirectional trams have significant cost, safety and passenger capacity/facilities advantages but do not have any disadvantages other than urban space constraints on providing balloon loops. Even this constraint can usually be overcome by running a loop around a street block. It is thus hardly surprising that unidirectional operation is extensively used in Europe's tram-savvy countries, but quite puzzling that newcomers to light rail are so reluctant to consider it (except where there is a legitimate reason for deciding against it).

Conclusion

My analysis is based on consideration of a new system in Sydney that could have very heavy usage. It is not intended that, apart from side-island platforms, any of the concepts discussed in this article be necessarily promoted for other Australian systems. Melbourne, for example, is locked into a long-established bidirectional system and there may be no significant reason to change that. Analysis of evidence does, however, suggest that there is more disadvantage (particularly cost and safety issues) than advantage in the use of central island platforms which so far seem to have been accepted uncritically (but with some concern in Melbourne) in development of some Australian light rail systems.

The use of unidirectional trams and balloon loops is something probably more relevant to systems that are likely to have huge demand, such as in Sydney, but they do have significant additional side-benefits in the areas of vehicle cost, safety and passenger amenity. I feel that Gold Coast and Adelaide should not preclude them from consideration, depending on how they see their systems developing. There is nothing worse than being overwhelmed by demand that your system cannot provide for, as Adelaide has found, and unidirectional trams and balloon loops provide that extra margin of capacity.

In view of these factors, I consider it very desirable that systems install side platforms only, even though they might be currently running a bidirectional operation, both because of the safety and other issues and so as not to lock future administrations out of converting to unidirectional operation should circumstances make it desirable in the future. Otherwise those administrations will not thank us for our lack of forethought! (It should be noted that, even on side platforms, bi-directional trams are no less prone to wrong-side door incidents. Although the hazards of falling into the path of an opposite-running tram may be perceived to be slightly less than those of falling into a stream of motor traffic, failsafe mechanisms or fencing between the tracks would also be desirable at such platforms for as long as bi-directional trams are using them.) Tramway designers and operators should firmly assert the cost and safety needs of trams over the unfounded whims of road authorities.

In conclusion, I am disturbed at the tendency to make huge assumptions and at the reluctance to 'think outside the square', particularly as new Australian systems have the opportunity to start with a clean sheet. The poor example of an analysis of unidirectional operation in the Perth study is inexcusable and it is noted that consultants often appear to be not behind the eight-ball in their knowledge and understanding of light rail technology and the rapidly-changing technological scene. There is certainly a notable lack of hard independent engineering analysis and willingness to question the claims of systems and vehicle manufacturers pushing their own barrows, resulting in systems being locked into second-best compromises. Light rail proponents and their technical advisers must bring more critical and informed insight to bear on the issues.

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This photograph of B 2055 in Bourke Street on 18 March shows the very wide and well equipped stops in the mall in this busy night scene.