

WHITEPAPER



# Bus Operations in the Autonomous World

By David Panter



**A**utonomous vehicles are about to arrive on our streets. When they do, they will not only change the way we use public transport but have the power to change the public transport companies themselves. The winners from this technology race will be the travelling public, supportive transport authorities and agile transport companies prepared to embrace new operational paradigms, new markets and new competition.

Running a bus company is a challenging task. In addition to managing personnel and assets, operators in Australia and New Zealand also need to comply with new performance-based contracts that specify where and when a bus is expected to operate. These performance contracts are often based on the level of service that transport authorities need to deliver to their customers. On-time running has traditionally been sought as a key deliverable.

Recently we have seen Public Transport Victoria raise the on-time performance bar for trains and trams<sup>1</sup> with penalties of up to \$1.2m<sup>2</sup> for poor performance. This has certainly caught operators' attention. But just as public transport authorities and operators are striving to achieve these expectations, it is possible that technology is going to radically change the meaning of 'customer service'.

### THE "FIRST/LAST MILE" PROBLEM

On-time running has always been a key performance indicator and this is not likely to change. However, a more difficult challenge recognised by both transport authorities and bus companies is the

1 <http://www.abc.net.au/news/2017-09-12/metro-contract-extended-for-melbournes-train-network/8895462>

2 <https://www.railexpress.com.au/steady-punctuality-stats-for-vic-trains-and-trams>, 15 Nov 2017

need to address the "First/Last Mile" of a passenger's journey. The question is: **how to do this at a reasonable price?**

For a long time this was simply too hard. However, emerging technology is changing this narrative, and transport authorities and bus companies are not blind to this opportunity.

The current discussion in Australia is now around Mobility as a Service (MaaS) and Demand Responsive Transport (DRT). What can we do with it? Where is it a viable offering? [Transport for New South Wales](#) and Queensland's [Department of Transport & Main Roads](#) are both running limited trials to help them understand DRT technology and see how they can use it to improve customer service.

DRT offers the flexibility to change routes or divert from a fixed route and to run (or not run) a service in response to fluctuating passenger demand. In some parts of Europe, DRT is used as a replacement for fixed route services with low or infrequent patronage. The routes and stops may be fixed or variable, and the services only operate if a trip is booked. For example, Vechta (Germany) uses DRT to connect residents in remote areas to community centres and trunk public transport services such as the train station.

In America, DRT is primarily focussed on paratransit and is used to provide access to the disadvantaged, the elderly or people with disabilities. However, it is relatively expensive and is heavily subsidi-

sed by Government. In Australia, paratransit services are primarily delivered by specialist taxis and council-based bus fleets—again, at a significant subsidy.

Across the globe, delivering last mile services for **all** passengers using traditional DRT solutions has previously not been commercially viable. In the Australia/New Zealand market, transport authorities are still wrestling with how to deliver last mile services at an acceptable price. **However**—this is all thinking within the currently familiar operating paradigm.

Let's step outside the box and consider what happens when we have autonomous vehicles capable of navigating the streets without a driver.

### THE FUTURE: NOT AS FAR OFF AS YOU THINK

There are various estimates on when autonomous vehicles are likely to be readily available. Quartz media<sup>3</sup> suggests the manufacturers are targeting 2-3 years, while a recent report by the Victoria Transport Policy Institute<sup>4</sup> suggests widespread use in 10-30 years.

One thing everyone agrees on is

3 <https://qz.com/943899/a-timeline-of-when-self-driving-cars-will-be-on-the-road-according-to-the-people-making-them/>

4 Todd Litman (2017), *Autonomous Vehicle Implementation Predictions - Implications for Transport Planning*, Victoria Transport Policy institute. <https://www.vtpi.org/avip.pdf>

that **autonomous is coming**—autonomous cars, autonomous trucks and autonomous buses.

Trapeze and **AMoTech** believe a shorter timeframe is more likely and, recognising the opportunities autonomous vehicles provide, have created a mobility laboratory at the Rheinfall in Neuhausen, Switzerland.

Having already integrated self-driving vehicles in its operations control backend, Trapeze plan to incorporate their own autonomous vehicle into the existing bus fleet and network of the **Schaffhausen Transport Authority (VBSH)** and operate it on a regular schedule along a defined route.

**AUTONOMY IN ACTION**

**Savings for operators**

Given that 50-60% of a bus operator's costs are driver wages<sup>5</sup>, it has been commercially unviable to have traditional buses sitting idly in the suburbs. However, take the driver out of the picture and immediately bus companies can be more flexible in where vehicles are located and operate.

Autonomous buses can also be smaller and cheaper to run than a full-size bus. One example already available is the **Navya ARMA**, an autonomous electric shuttle bus. With fuel representing 15-20% of an Australian operator's costs and predicted energy costs of electric vehicles being around 20% of that of a diesel bus<sup>6</sup>, there are compelling reasons to embrace all electric transportation. Historically, full-size battery-powered buses have not stacked up<sup>7</sup>. However, in a new world of small,

5 Mel Pecen (2015), Urban Mobility India Conference and Expo 2015. Trapeze Group Asia Pacific.

6 Michael Linse, Zach Barasz, <http://www.kpcb.com/blog/urban-transportation-will-go-all-electric-sooner-than-you-think>. May 2015

7 MRCagney, Electric Bus Technology – Transport Research Report, MRCagney July 2017

lightweight electric vehicles, wide acceptance of these vehicles will result in a proliferation of charging points and mass production will drive down capital costs, changing this paradigm.

**New passenger experiences**

The biggest change will be in passenger experience, as autonomous vehicles radically change what services we are able to offer. We envision a future where it will be possible to give every passenger a limited stop, high-speed, line haul service followed by a trip almost direct to their door.

Bus fleets will shift to larger line haul buses (articulated buses, double-decker buses and the like), working in conjunction with trams and trains to move significant numbers of people between key points fast and frequently. These fleets will be supplemented with large numbers of autonomous vehicles that are garaged in the suburbs and pre-located at key interchange points.

Passengers will be able to book a door-to-door trip with their smartphone, using the line haul buses to get from the city to an interchange point (just as they do now), and then using a smaller autonomous vehicle for the last mile. The booking mechanism will cover the entire fare. A modern Be-In/Be-Out (BIBO) ticketing mechanism that taps into the customer's smartphone can be used to validate their ticket.

Suitable scheduling algorithms will group commuters together (including those from different line haul trips) to minimise the hub-to-stop or hub-to-door travel time. Dynamic routing will enable these vehicles to pick up and drop off customers, with individual routes determined on the fly. Riders will no longer have to take the predefined fixed route through the suburbs just because that was the best historical way for a large bus to pick up passengers.

These micro services will be linked to line haul services, with connection protection in place to guarantee minimal delays when changing modes. It is even possible to link services so that passengers can be confident that when they get off the micro service, they will get a seat on the line haul services.

**Bus stops be gone**

Bus stops are headed the way of the dinosaurs. Soon they will not be needed in many suburbs as there will be no formal routes to be serviced. However, if desired, the bus stop of the future may morph into a shelter and smart calling point equipped with a touchscreen. Passengers will be able to walk up to it or park and ride, then request a bus to their destination.

With autonomous vehicles servicing the last mile, a smart control system will determine if it is more efficient to use one vehicle for all the passengers at a stop or



to take some people now and dispatch a second vehicle to take the rest. Passengers will be informed of these decisions via their smartphones, which will indicate the waiting transfer vehicle number, as well as live updates on the smart bus stop's signage.

### Opening up commercial opportunities

With passengers taken care of, smart bus companies will look to maximise the use of their autonomous vehicle fleets and their ability to run all day and night for only marginal costs. **Commercial opportunities well beyond the scope of carrying people abound.** In fact, this technological leap has the ability to shift a bus company from moving people to moving both people and goods.

#### En route services

En route services will add value to the existing travel patterns. This value could be through additional passenger services and goods deliveries.

It is not difficult to imagine an ancillary service making use of the planned arrival time of each passenger: customers can use their mobile phones to order and pay for a coffee or snack before travel or during a trip on a line haul service. Vendors, knowing individual passengers' arrival times, will have a known lead time to finish preparing the necessary goods. Commuters can then pick up their pre-paid food or drink at the interchange point with minimal waiting time.

#### Delivery services

Buses could tightly integrate with local restaurants and become delivery services, either delivering takeaway meals to passengers already on the bus (so the restaurant becomes another stop in the sequence) or delivering local packages door to door. **UberEATS** seeks to do this right now with kerbside-only deliveries, but a progressive bus company could go so much further.

Imagine small (6–8 people) electric vehicles with externally accessible loading bays on the kerb-facing side of



the vehicle. These bays can be secured with mobile phone near-field communication (NFC) technology, so customers can just use their phones at the appropriate door to retrieve their packages.

Delivery charges could reflect the cost of delivery plus the demand on the buses. For instance, a premium fee might apply during peak hours (say 5.00pm–7.00pm) then a lower fee for 7.00pm–8.00pm, and a lower fee again after 8.00pm. Interestingly, Domino's is **already testing** the use of autonomous cars for pizza deliveries, and are focusing on the customer experience in the last 15m.

Groceries could be ordered online, with deliveries at night when people are home. Your phone would advise when the delivery will arrive at your house; you just need to go outside, wave your phone at the storage unit on the side of the vehicle and take your groceries. This could all happen on the same day as public transport last mile services, with the later deliveries attracting a lower fee.

#### Staying focussed

Remembering that moving people is still the main game for a bus company, operators will need sophisticated control systems that allow delivery priorities to be adjusted so that passengers are not unnecessarily waiting due to

product deliveries. Dynamic routing will allow goods drop-offs to happen as or after passengers are sent to their homes, depending on the overall demand and delays.

Depending on load and downstream stops, a small window of time would exist to retrieve your goods. If you fail to retrieve them in time, the bus will continue on its schedule and you would need to book a second delivery (at additional cost).

This second delivery would be automatically planned into the next route and you will be advised of the new time via your phone. Today's demand responsive travel applications such as those Trapeze supply globally can already manage no-shows, blacklisting and dynamic routes—so extending this concept is not only possible but entirely feasible.

### Taking action

This is a time of great change. This change could mean a radical shift in what a bus company is, how it will work and how it can generate additional income. Now is not the time to be complacent.

The taxi industry has been battered by Uber, Lyft, and other ride-sharing companies embracing new business models in a mobile world. Uber has already **recognised the value of auto-**

omous vehicles and sees the clear financial advantages of not having a driver for point-to-point travel. Given they will soon have this technology in place, they are well-positioned to bid for final mile delivery work.

Leading bus companies will not cede their position lightly and will grasp this opportunity to seize the day. There will be winners all round:

**Bus companies** will win more work with lower operating costs, increased revenue and stronger profits as they work with new markets and new products.

**Transport authorities** will win when bus companies are able to derive funding from other sources, as they will be able to deliver significantly enhanced services at a lower cost. In a fiscally tight world, this will be warmly welcomed.

However, the biggest winners of all are **passengers**. They will receive a significantly better experience at lower costs; a city-to-door commute in less time with only a single, hassle-free interchange; value-added delivery services and new products; and a higher quality of life through improved public transport.

These are interesting times indeed.



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If you have questions about autonomous vehicle and control centre integration, or would like someone from Trapeze to provide consultation on your organisation's options for intelligent transport solutions, please contact [info@trapezgroup.com.au](mailto:info@trapezgroup.com.au)

Trapeze Group works with public transport organisations and their communities to develop and deliver smarter, more effective public transport solutions. For more than 25 years we have been Here for the Journey, evolving with our customers around the world to helping them move people from point A to Z, and everywhere in between.