PROJECT NO: 3-023

Frictionless Ticketing for Public Transport: Appendix 2: Stakeholder engagement

July 2022

This research for TfNSW is funded by iMOVE CRC and supported by the Cooperative Research Centres program, an Australian Government initiative.

LA TROBE UNIVERSITY | Centre for Technology Infusion

About this Appendix

This project is a collaboration between Transport for New South Wales, iMOVE and The Centre for Technology Infusion with the objective to evaluate emerging technologies that can deliver frictionless ticketing for public transport.

This appendix provides details and substantiation of the findings in the main report. To keep the main report readable, we have included full reports of stakeholder engagement and industry scans in this appendix.

1: Engagement with People with Disability
2: Engagement with Operators

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1: Disability Stakeholder Consultation Report

Introduction

Many customers with disability face barriers while accessing and using Transport for NSW's (Transport) ticketing system when travelling on the network. Where a customer is unable to use the ticketing system, Transport currently offers an alternative pass that provides free travel. However, difficulties with this arrangement can sometimes occur if staff are not present to assist pass holders with opening the gates. This also means that there is no record of pass holders using public transport, an important factor for capacity planning, real time information about the availability of priority seats, emergency situations, etc.

There are several technologies that can help automatically capture entry and exit of transport users on or off the platform or a vehicle. iMOVE and the Centre for Technology Infusion have been contracted by Transport to undertake a research program to explore new and emerging technologies that can offer a true frictionless ticketing experience to transport customers across multiple modes.

'Frictionless' payment means that public transport can be used with little or, ideally, no effort. For example, in the USA, in some stores you can just pick up products from the shelves, walk out of the supermarket and the payment is automatically undertaken (if you have the right app and are signed up).

The research outcome of this project is to clarify the key strengths and challenges of new and emerging frictionless ticketing technologies. Outcomes will explore technology options that will ease connected transport journeys across multiple modes including interchanges. As a result of this research program, Transport will aim to co-design new research trials that will assess how frictionless ticketing propositions can truly enhance the public transport customer experience.

This initial report provides a detailed account of stakeholder feedback on the proposed technologies, obtained through a series of consultations, and focus groups.

Methodology

The Centre for Technology Infusion, with the assistance of the Physical Disability Council of NSW (PDCN) and the Australian Federation of Disability Organisations (AFDO), undertook a series of four online focus groups and consultations with people with disability, peak Disabled Peoples Organisations and experts with lived experience in the public transport field.

Ethics approval has been obtained, and all participants were provided with an information statement, an information session about the project, advice on how they could manage any complaints regarding their participation, or withdrawal of consent and required completed consent documentation prior to participation.

Prior to the focus groups and peak and expert consultation sessions, two 1.5 hr information sessions were run to brief participants on both the emerging technologies in this arena, and to provide an overview of the function of the four frictionless ticketing solutions that would be discussed in the secondary consultations.

The four frictionless ticketing technology solutions included the following:

1. Smart Phone
2. Token
3. Biometrics
4. Assistive technologies/Wayfinding

Table 1 Frictionless ticketing options

	Smart phone	Wearable token	Biometrics	Assistive technologies
What is it?	An app on your smart phone or your smart watch.	A small device, like a key chain or armband. (It can take many forms)	A device on the train station or bus stop that can read a biometric characteristic. (facial, fingerprint, voice, etc.)	A body camera for people with disability that 'looks out' for you and guides you.
What does it do?	It will 'tap-on' and 'tap-off' for you automatically.	It will 'tap-on' and 'tap-off' for you automatically.	It will 'tap-on' and 'tap-off' for you automatically, when the camera recognises you. Or Use your choice of bio-metric identification. (voice, finger print, face, other)	It will 'tap-on' and 'tap-off' for you automatically.

Prior to the consultation sessions, documentation was provided to all the participants to ensure all had the same information and level of understanding regardless of the session in which they participated.

Two 2-hour focus groups were conducted online (via Zoom) for people with disabilities, with participants representing physical, cognitive, psychosocial and sensory (vision) disabilities. A total of 12 persons took part over the two sessions and were recruited through the Australian Federation of Disability Organisation's member base. Half of the participants reside in NSW, the other half in VIC. The range of disabilities included Physical disability, uses mobility aid, MS, Mobility impaired, wheelchair user, blind, acquired Brain Injury, Autism, Wheelchair user, Blind and Guide Dog and one person who was blind and had poor cognitive abilities.

A peak body consultation session (also conducted online via Zoom and 2-hours in duration) was conducted with 13 representatives from the following 11 organisations:

1. Blind Citizens Australia
2. Deaf Society
3. Deafness Forum
4. Guide Dogs NSW ACT
5. NSW Council for Intellectual Disability
6. Paraquad
7. People with Disability Australia
8. Physical Disability NSW
9. Spinal Cord injuries Australia
10. Stroke Recovery Association
11. Vision Australia

The final consultation was undertaken with participants with lived experience, considered experts in the field of public transport. This session was conducted online via Zoom and ran for 1.5 hours duration. There was a total of 7 participants in this session with physical, cognitive and sensory (vision) disabilities.

There was a total of 5 participants in this session with physical, cognitive and sensory (vision) disabilities.

Geoff Trappett	AFDO (and Inclusion Moves)
Jenifur Charne	Disability advocate
John Moxon	Disability advocate, wheelchair user
Peter Simpson	Accessibility consultant, member of Aviation Access Committee
Martin Stewart	Advocacy Officer, Blind Citizens Australia

With the consent of all participants, sessions were recorded, and a number were also live captioned, or AUSLAN translated.

Discussion within the two focus groups and two consultations was broken into four main topics;

1. the pros and cons of each technology for any specific disability
2. ideal whole of journey user experience
3. interaction between the technology and human input
4. arguments for implementing this technology

For all conversations participants were asked to assume the technology worked as expected so that the conversation could focus on the use case requirements, not on the 'how'.

Exploration of frictionless technologies opportunities and issues

Across the four consultations a wide variety of responses were gathered for each of the four topics discussed (pros and cons; user experience; human/tech interaction; and arguments for implementation) though overall, with the exception of those representing people with a cognitive disability, participants were favourable in their views of the implementation of a frictionless payment system of some sort.

Whilst automation was an aspect that excited many, others were quick to advise that the retention of a human element within the system was important, particularly to assist when things did not go to plan, such as changes to timetables or platforms, during emergencies, or when unsure and needing assistance to navigate the system.

People with disability currently struggle to be equally included in the public transport system and wanted to ensure that any frictionless payment system implemented was one that meets universal access principles and included everyone, not only those with disabilities.

There was no 'one size fits all' solution, with many participants indicating they would be more comfortable if they had a second 'fall back' option alongside of their preferred frictionless payment solution.

Findings

1. Pros and Cons of frictionless technologies

The start of the discussion broke down the pros and cons of the four frictionless payment options (phone, token biometrics and wayfinding) provided to the participants, with the phone and token seemingly getting the most initial 'buy in'.

> *"My preferred option would be the phone option. We're so used to carrying our phones with us all the time for QR codes and all those sorts of things, it's always by my side and it would be the simplest."*

> *"I have schizophrenia, which affects my memory as well. So, for me, the smartphone, I thought that was a good idea because I use it every day and that's convenient."*

> *"I think my first preference would also be the token, just simply because it's specific and separate to transport and everything else seems to be getting lumped on to our phones and I suppose the other I'm glad you clarified about saying you don't need to wave it or anything because when I'm having coordination issues, that would certainly be an issue to be trying to undo a phone and all of that sort of stuff, but I think just to be able to have a token that's a case of yes, this is just for public transport and nothing else."*

> *"A tag for a guide dog harness would be preferrable. Guide dogs are able to travel everywhere their owner goes."*

> *"My preference would be an industrial strength token that I could just put on a chain around my neck. And it just wouldn't come off, except maybe in you know the public pool or something with the chlorine would destroy it."*

The drawback of these to some was the need to carry physical items, though it was noted that most people already carry a mobile phone. Additionally, there was concern as to what would happen if your phone power died, there was no reception or no data available. For some cohorts, stroke and cognitive disabilities in particular, barriers to phones and token were also identified.

> *"What would happen if prepaid data ran out, or they were in a black spot?"*

> *"Not everyone has a phone – many people with disability experience poverty "give us all a free phone and we'll all do it"*

> *"I might drop my phone or something. And having to get it out and wave it might be problematic."*

> *"Token could be issue with the way people with intellectual disability will move, assumption on virtual gate. Physical movement can be difficult for people with intellectual disability - they get lost, confused and may stay in one place a long time, or may also pass through an area multiple times and get 'pinged' for payment multiple times."*

> *"A token could be left behind but could also be good as it is small and convenient."*

Biometrics was understood to be the most convenient, in that you did not have to have any form of technology with you, other than oneself, however it was also the most controversial, as many participants were not comfortable with a public entity gaining their biometric data.

> *"So, the idea of having somewhere where you actually don't have to do anything, that just recognises your face or some other method would be really beneficial, that we could just turn up and use the service that we need to use without needing to do any of that planning and remembering and steps with technology."*

> *"The idea of facial recognition, I think that would be absolutely ideal, that I can just turn up and use the service without having any additional steps or any of those planning issues to worry about. I think that would just be absolutely perfect and I know that that would really benefit my kids because they have my youngest son has an intellectual disability and is autistic and he has massive anxiety, so he does a lot of part of his anxiety has to do*

he tries to make everything perfect and does a lot of planning, which creates a lot of stress and it becomes this cycle for him."

"If the facial recognition was perfect and reliable it would be preferred option – because then I don't need to take anything."

"The idea of biometrics, I'm really, really, not happy with on any level at all, so that's not something that I would be wanting to have to do just to get on a train or get on a bus."

"There are potential difficulties with facial recognition, can be very hard for some people with disabilities to get accurate readings, for example, if they shake."

Wayfinding technology appealed to those with a vision impairment, as many are beginning to use technologies such as LIDAR to assist them in independently finding their way around the community. Other disability cohorts not as familiar with wayfinding technology as the vision impaired cohort, saw it as needing an additional piece of hardware that they did not want to have to carry with them.

"Lidar is also a good option because it will guide the person to the gate and assist them to navigate getting on the train etc. An App that syncs to an apple watch would be good."

"As far as something like a wayfinding app, whether it's glasses or something like that, for me the theory of them is good and when I'm well, they're fine, but when I'm not well, getting that extra sensory input I've had a number of arguments with Google because it overloads me and it just gets too much and I have problems just basically my whole processing slows down, so a lot of things when I'm unwell that I normally take for granted as sort of an automatic thing that occurs, all of a sudden I'm having to think about things that I'm normally doing automatically and fluidly, so to have extra sensory input to be telling me, "No, go left" or "at 200m you're going to hit the gate", for me personally, I don't have a vision problem. If a gate is marked, I should be able to see that. I wouldn't want something in my ear telling me "go here, go there". I'd probably have a little 'spac attack' and dropping it or something."

"Do we want an additional thing to wear/carry? Practicalities to be considered."

Alongside of the individual technologies, participants raised questions that concerned all of the four technologies put to them for consideration. They wanted to know how any of these would work in a situation where a person with disability had a companion with them (using the free companion travel card) and wanted assurance that there would still be transport staff in the system – at stations, on transport – that could assist when needed. Alternatively, they discussed the ability of any of the four technologies to be able to call for assistance.

"What would happen when there is a companion? How does the companion ensure they are not charged twice (if they have both a companion token and a personal one (for when they are not assisting someone.)"

"PWID want a human being – want to be able to speak to someone and ask questions, get assistance. Public transport use can be intimidating – rushed, aggressive, has deadlines. PWID want assistance and guidance to know that they are doing the right things."

"There needs to be a viable backup to whatever technology is adopted so that there is an easy gateway to communicate the issue. Person to person is best."

Table 2 below includes all comments regarding the pros and cons of the four frictionless technologies discussed (from all four consultation sessions)

Table 2 Frictionless ticketing options

Common Topic	Direct Quote	Disability (if known)	Session
Phone - Advantages	My preferred option would be the phone option. We're so used to carrying our phones with us all the time for QR codes and all those sorts of things, it's always by my side and it would be the simplest.	Physical	PWD 1
Phone - Advantages	Phone app is a good option for me	Psychosocial	PWD 2
Phone - Advantages	A phone App that syncs to an apple watch would be good.	Blind/Vision Impaired	PWD 2
Phone - Advantages	Smart phone App version to use would also be good as well, especially if it links with wayfinding/mapping, but also access to humans is essential	Blind/Vision Impaired	PEAK
Phone - Advantages	I have schizophrenia, which affects my memory as well. So, for me, the smartphone I thought that was a good idea because I use it every day and that's convenient.	Psychosocial	PWD 2
Phone Disadvantages	Do you have the manual dexterity to action, or is it just on all the time? Second issue – did you have it with you? What if the battery dies?	Physical	EXPERT
Phone Disadvantages	Phone – hot spotting – sometimes this may not work – I would feel a smart watch needed as well to feel vibrations and know it worked.	Deaf/hearing impaired	PEAK
Phone Disadvantages	What would happen if pre-paid data ran out, or they were in a black spot?	Deaf/hearing impaired	PEAK
Phone Disadvantages	What if someone tapped repeatedly? What indication would they get?	Deaf/hearing impaired	PEAK
Phone Disadvantages	There are people who don't have phones - with that technology I think that would be a barrier.	Cognitive	PWD 1
Phone Disadvantages	not everyone has a phone – many people with disability experience poverty “give us all a free phone and we’ll all do it”	Physical	PWD 2
Phone Disadvantages	The phone is not accessible for people with an intellectual disability – issues of technology, price and data. Not a technology they have, or easily understand, so couldn’t use for this purpose.	Cognitive	PEAK
Phone Disadvantages	Technology – not everyone has a smart phone, and if they do have it – it is only used for contacting and tracking (they don’t understand and use the technical features)	Acquired Brain Injury	PEAK

Phone Disadvantages	For people without that specific technology or a different phone where they couldn't download apps, then that would be an enormous barrier.	Psychosocial	PWD 2
Phone Disadvantages	Only if my battery was flat or I, for some reason, left it at home. But that wouldn't normally be the case.	Blind/Vision Impaired	PWD 1
Phone Disadvantages	I might drop my phone or something. And having to get it out and wave it might be problematic.	Physical	PWD 1
Phone Disadvantages	My only concern would be exactly as the person who spoke before me, (whose name I don't remember, sorry) if my phone ran out of charge, that might be problematic, so that is why I was thinking a token might be useful as well.	Physical	PWD 1
Phone Disadvantages	Well, poverty and disability, people don't have a bloody phone so I think the idea of the fob is better.		PWD 2
Phone Disadvantages	To be honest, because I don't use the telephone a lot, like I tend to have a prepaid mobile and if it's requiring an internet, I don't always have internet on my phone. I really do struggle with executive functioning so that whole thing of having to recharge and have a phone that's got battery power and just to remember to have it with me is really difficult. So, anything that would rely on a phone app would really take quite a lot of planning steps for me to do, not just for myself but for my children as well.	Cognitive	PWD 1
Phone - disadvantage	Also, rural areas may not have the infrastructure to maintain complex systems, no signal. Technology is seen as less reliable. Things are not maintained as well.	Physical	PWD 1
Token - advantages	If I use transport all the time, the token might be a good option. I would put it on my guide dog harness, but because I don't use it all the time, there's a good chance I would lose it because I would put it away somewhere safe and potentially forget about it.	Blind/Vision Impaired	PWD 1
Token - advantages	A tag for a guide dog harness would be preferrable. Guide dogs are able to travel everywhere their owner goes.	Blind/Vision Impaired	PWD 2
Token - advantages	I think my first choice would be the token because it's something I could wear. I could wear it on a lanyard, and it's one less thing I can drop if I've got it on my person.	Physical	PWD 1
Token - advantages	Whatever it is must be easy – a fob that attaches to a handbag	Physical	PWD 2
Token - advantages	I think my first preference would also be the token, just simply because it's specific and separate to transport and everything else seems to be getting lumped on to our	Physical	PWD 1

	phones and I suppose the other I'm glad you clarified about saying you don't need to wave it or anything because when I'm having coordination issues, that would certainly be an issue to be trying to undo a phone and all of that sort of stuff, but I think just to be able to have a token that's a case of yes, this is just for public transport and nothing else.		
Token - advantages	I just suppose that in terms of my initial thought of it when you were saying a token, I was thinking something that looks half the size of a highlighter on a key chain or something like that, but if it wasn't that sort of chunky piece of plastic that you have to hang on to, if it looks more like a yes did card, that's something that is easy to get slotted in with other IDs.	Physical	PWD 1
Token - advantages	My preference would be an industrial strength token that I could just put on a chain around my neck. And it just wouldn't come off, except maybe in you know the public pool or something with the chlorine would destroy it.	Acquired Brain injury	PWD 2
Token - advantages	Going back to the token as a card, that would work very well for me as well if it wasn't too thick and I could slot it into my purse and leave it there forever. That would be a good option for me. Before when you were talking tokens, I was thinking about something around your neck or a separate chunky device.	Physical	PWD 1
Token - advantages	Token – better option to fit deaf people. Deaf people walking through a gate – seeing a light is good, but what about deaf/blind? It would be hard to find something that would suit everybody.	Deaf/Hearing Impaired	PEAK
Token - advantages	Token better choice. However, the idea of a vibration would be essential to know that they have paid, and a monetary transaction occurred.	Acquired Brain Injury	PEAK
Token - advantages	Token, good and simple for a lot of people	Blind/Vision Impaired	PEAK
Token - advantages	Token and vibration are essential to know things had worked.	Blind/Vision Impaired	PEAK
Token - advantages	A token that that has a hole in the centre of it so like a washer that you would use on a tech so that you can either thread it onto a chain or you could, you know, put it on a key ring of those sort of things. Think it needs to be transportable, whatever it is. So, it needs to be able to be worn on your person on yourself somehow.	Physical	PWD 1

	So, I totally agree something so it's easy to carry and not to forget what could go wrong with it, would you put in the washing machine.		
Token - advantages	The token, whether it be something attached to the mic, like a microchip, a pendant. I would prefer those. I worry too much with getting my card, like I'm fidgeting, then I don't remember. Sometimes I'm good with it. But if it was around my neck or a bracelet, it would be terrific.	Physical	PWD 1
Token - advantages	If the token is a smart token, it would then know where you were, and could feed info back to phone or token (with speaker for blind people)	Blind/Vision Impaired	EXPERT
Token – advantage/disadvantage	A token could be left behind but could also be good as it is small and convenient.	Psychosocial	PWD 2
Token - disadvantage	Reach can be an issue; scanning can be very difficult because there is a “hodge podge” of heights of scanners.	Physical	PWD 2
Token - disadvantage	Token could be an issue with the way people with intellectual disability will move, assumption on virtual gate. Physical movement can be difficult for pwid, they get lost, confused and may stay in one place a long time, or may also pass through an area multiple times and get ‘pinged’ for payment multiple times.	Cognitive	PEAK
Token - disadvantage	How far away does the token read from the device? In the big train sessions and transit centres, if you're walking past a bunch of validators, then is your token going to get picked up by a number of those? So, there's a whole raft of technical issues that come with the ease of something being able to not have to be in your hand.	Physical	EXPERT
Token - disadvantage	What about false ‘taps ins?’ If there are multiple places to tap on/off along a platform and how would that work if they each pick up the token and register it?	Physical	EXPERT
Token - disadvantage	A ‘dumb’ RFID tag works well to open a single gate, but if walking along a footpath next to a train station, you may get false tap on/off with infrastructure that is closely located within the station. But no way of touching out at the end – so info isn’t accurate.	Physical	EXPERT
Token - disadvantage	The token, the biggest issue we have as a family is things just get lost and I think I mentioned in the meeting yesterday classic example is Opal cards. We are always losing them, misplacing them, not having them, my kids are always losing their school travel passes. They spend most of the term without a travel pass than they ever have with it because there's also that takes time to get replacement ones.	Cognitive	PWD 1

Biometrics - advantage	Biometrics could be very convenient for me	Psychosocial	PWD 2
Biometrics - advantage	So, the idea of having somewhere where you actually don't have to do anything, that just recognises your face or some other method would be really beneficial, that we could just turn up and use the service that we need to use without needing to do any of that planning and remembering and steps with technology.	Cognitive	PWD 1
Biometrics - advantage	The idea of facial recognition, I think that would be absolutely ideal, that I can just turn up and use the service without having any additional steps or any of those planning issues to worry about. I think that would just be absolutely perfect and I know that that would really benefit my kids because they have my youngest son has an intellectual disability and is autistic and he has massive anxiety, so he does a lot of part of his anxiety has to do he tries to make everything perfect and does a lot of planning, which creates a lot of stress and it becomes this cycle for him.	Cognitive	PWD 1
Biometrics - advantage	Facial recognition might also be useful, although consent could be an issue and might be unreliable.	Acquired Brian Injury	PWD 2
Biometrics - advantage	If facial recognition was perfect and reliable it would be the preferred option – because then I don't need to take anything.	Blind/Vision Impaired	PWD 2
Biometrics - advantage	As long as it is algorithm coding (not photo) so people's sensitivities are taken into account	Blind/Vision Impaired	PEAK
Biometrics - advantage	Many people use facial recognition on their OWN phones, so if this was the way it happened, this would be fine.	Blind/Vision Impaired	PWD 1
Biometrics - disadvantage	Having some gates that are facial recognition would be very difficult. Guide dogs would have to learn the particular gate at a particular station	Blind/Vision Impaired	PWD 2
Biometrics - disadvantage	Face recognition isn't always great because some days it works, some days it doesn't, more often than not, it doesn't.	Physical	PWD 1
Biometrics - disadvantage	There are potential difficulties with facial recognition, it can be very hard for some people with disabilities to get accurate readings, for example, if they shake.	Physical	PWD 2
Biometrics - disadvantage	What happens if their face is swollen on the day that they need to use it? Would it work?	Deaf/Hearing Impaired	PEAK
Biometrics - disadvantage	The reason I'm worried that facial recognition is because there's a whole bunch of things concerned with consent and things like that. Yes, but the thing is that my telephone is supposed to be smart enough to have facial	Blind/Vision Impaired	PWD 1

	recognition yet it dropped out after the first two weeks, and nobody's been able to put it back on again.		
Biometrics - disadvantage	Facial recognition, is it something at the station or is it a device located at the station? This wouldn't work for blind people if they didn't know where the screen was located to use it.	Blind/Vision Impaired	EXPERT
Biometrics - disadvantage	Facial recognition, whilst technology can do this, has been forced upon us, and many people may not choose to use this.	Physical	EXPERT
Biometrics - disadvantage	People would hesitate if it was a 'govt' device at a station to be recording our personal details.	Blind/Vision Impaired	PWD 1
Biometrics - disadvantage	And I don't particularly like the face recognition option. I imagine as a vision impaired person; you would have to be in a particular location which could create more difficulties.	Blind/Vision Impaired	PWD 1
Biometrics - disadvantage	The idea of biometrics, I'm really, really not happy with on any level at all, so that's not something that I would be wanting to have to do just to get on a train or get on a bus.	Physical	PWD 1
Biometrics – advantage/disadvantage	Facial recognition might also be useful, although consent could be an issue and might be unreliable. (Participant noted that their phone should have facial recognition, but it doesn't work.)	Acquired Brain injury	PWD 2
Biometrics - disadvantage	Privacy and facial disfigurement are issues for stroke survivors. Would biometrics work for them?	Acquired Brain injury	PEAK
Biometrics - disadvantage	Still people somewhat suspicious of this technology	Blind/Vision Impaired	
Biometrics - disadvantage	I have fears of being cloned	Psychosocial	PWD 2
Wayfinding - advantage	Lidar is also a good option because it will guide the person to the gate and assist them to navigate getting on the train etc. An app that syncs with an Apple watch would be good.	Blind/Vision Impaired	PWD 2
Wayfinding - advantage	Vocals are good, but there is a privacy issue. You want something that works with airphones.		PWD 2
Wayfinding - advantage	Technology can both help and hinder us, where we can grab it and use it, we should, particularly as it gets better. I want to be able to explore on my own, so if technology can do that I would be pleased. Wayfinding would be great.	Physical	PEAK
Wayfinding - disadvantage	LIDAR tech – very accurate, but problem LIDAR is only IOS technology at this stage? It doesn't work on ANDROID?	Blind/Vision Impaired	EXPERT

Wayfinding - disadvantage	I don't generally use wayfinding apps, so when you talk about cameras and devices and whatever, that would just require further expense I guess, and it would be quite clumsy and it would be an additional thing that needed to be gathered before you went on your journey.	Blind/Vision Impaired	PWD 1
Wayfinding - disadvantage	Well, I have a disability called motor dyspraxia as well, so my left and right isn't my best attribute, so I can have problems sometimes. I am better visually knowing where I am going, so it depends.	Physical	PWD 1
Wayfinding - disadvantage	As far as something like a wayfinding app, whether it's glasses or something like that, for me the theory of them is good and when I'm well, they're fine, but when I'm not well, getting that extra sensory input I've had a number of arguments with Google because it overloads me and it just gets too much and I have problems just basically my whole processing slows down, so a lot of things when I'm unwell that I normally take for granted as sort of an automatic thing that occurs, all of a sudden I'm having to think about things that I'm normally doing automatically and fluidly, so to have extra sensory input to be telling me, "No, go left" or "at 200m you're going to hit the gate", for me personally, I don't have a vision problem. If a gate is marked, I should be able to see that. I wouldn't want something in my ear telling me "go here, go there". I'd probably have a little ‘spac attack’ and dropping it or something.	Physical	PWD 1
Wayfinding - disadvantage	So, I'm pretty hopeless with apps. I have only just learnt that you can register an Opal card and transfer balances, so we've lost so much money over time with Opal cards, losing cards that don't have balances or cards that don't have a big enough balance to pay for the trip that we're doing so you get all of that kind of thing. Even just recently with having to sign into shops and supermarkets using QR codes, I still haven't got the hang of that. If I go out, I'll go out with my husband and he'll sign me in using his phone. So, it's something that to be honest, I would need to have some training on how to use any new technology like that or help to get that set up.	Cognitive	PWD 1
Wayfinding - disadvantage	Do we want an additional thing to wear/carry? Practicalities to be considered	Blind/Vision Impaired	PEAK
All – ticketing - disadvantage	I think there would be a little bit of concern with this process that currently people with vision impairments don't pay for tickets at all, so I think there would be some resistance that if you're getting a ticket and is electronic, that there would be a charge. So, I think that would be a barrier for a lot of people, that concern.	Blind/Vision Impaired	PEAK

All	Whatever it is, it must be easy for me!	Physical	EXPERT
All	Any option that doesn't require physical use (i.e., getting a phone out, or holding a token would be good)	Physical	PEAK
All	How do you get payment on any of the options provided? Many people with intellectual disabilities do not have credit cards, they go to a newsagent to pay cash onto a card. Many are under financial management through Guardianship and have very limited funds available to them.	Cognitive	PEAK
All	PWID want a human being, they want to be able to speak to someone and ask questions, get assistance. Public transport use can be intimidating – rushed, aggressive, has deadlines. PWID want assistance and guidance to know that they are doing the right things.	Cognitive	PEAK
All	What would happen when there is a companion? How does the companion ensure they are not charged twice (if they have both a companion token and a personal one (for when they are not assisting someone)	Deaf/Blind	PEAK
All	My organisation represents all disability types. Great potential to improve accessibility, potentially, but no 'one size fits all'. No ONE option that fits all people with disability.	All	PEAK
Any	I would like to have options for more than one device – at times using a phone may be hard, but then I could have a token that was attached to my wheelchair (that I didn't have to handle). I like the idea of multiple options.	Physical	EXPERT

2. Whole of journey requirements

There are many factors to be considered when addressing the use of frictionless technologies across a whole of journey (journey planning, account set up, through to journey completion) that participants indicated would be needed to make the process work to its greatest advantage.

These ranged from a simple process for online registration for the technology, preferred by most to be linked with a system they may already be using, such as Apple or Google pay, through Service NSW accounts, a MyGov account so that the need to provide identification was not duplicated, or in person by visiting the local post office or Service NSW centre.

> *"I suppose as far as the setup is concerned for the 100 points of ID with Service New South Wales or the MyGov app, I think by the time you have all that set up, I think most of that is pretty much validated that that's you and you're the correct person using the app. I suppose I'm personally still a little bit resistant to having my complete identity sitting on my phone. Just security purposes and all that stuff."*

> *"Yes, sure. I think with all the COVID stuff, the two apps I would use the most is the Service New South Wales app, which is a four-digit pin to get into. I then had issues even though I went on to my phone to download my COVID certificate, for some reason it was glitching and wasn't loading into Service New South Wales. I then discovered that I could view it through GPay. So, I know that's Google and not a government app but that seemed to work seamlessly when the Government app didn't work. I suppose the other thing with G Pay is my phone is Android so the Gmail and the identification thing from Google's perspective is already set up on my phone, so it already knew this was me and it was happy to integrate the certificate."*

> *"Could you turn up in person at Service NSW centres to enrol face to face as an option? This could help people who have difficulty with online or phone facilities. Here a person could assist them to establish an account."*

> *"I would need some assistance probably setting it up and that could be a designated phone line where people were going to take the time to talk you through it. That would be important for me. I have recently had to reset MyGov because I forgot my password and that was a bit of a saga and downloading my COVID certificate and all the rest of it, but it was something I was able to do with somebody really supportive on the other end of the phone."*

Automation was prominent – of the actual payment process (handsfree) and in notifying any need for assistance, such as the need for a ramp to board. Participants were happy to share disability specific information in the registration process if it led to automatic 'flagging' of access needs on their journey and reduced time-consuming pre-planning processes. However, it was noted that this should not be the only mechanism for flagging assistance.

> *"It needs to be instant, like a camera, you walk up to a gate you want it to pick up facial features as you go through the gate not have to face a certain way."*

> *"The more automated the service the better for me, one less thing I have to think about."*

> *"I want it to work such that the system knows I'm on the train and will need assistance at the end of my journey (i.e., ramp brought to the train) I would want an alert to let them know I'm coming."*

> *"Can it have a 'help me' function if I need assistance?"*

All cohorts requested the assurance of a confirmation feature when entering and exiting public transport – to enable them to know that payment had occurred. For some, this was a visual signal (such as a light flashing) for others an audible cue, or 'beep' – noting this needed to be differentiated from other typical sounds made by their phones to be distinguishable.

> *"Deaf people walking through a gate – vibration and/or seeing a light is good to provide confirmation."*

"I think also what it needs to have given is not just a beep. It needs to have a totally different sound to all the sounds that we have on our phones, I mean, we know many of them but a lot of them are so similar it's not funny - it needs to have a unique sound."

"There needs to be some indicator, like a beep to indicate that the App is being used"

Participants also wanted to know that they could go online to check their accounts, and ensure they weren't being overcharged (concern was raised around token technologies reading more than once if proximity was an issue) or to split payments for personal and business purposes.

"I would want to be able to check my account online, and make sure I wasn't charged incorrectly."

"I need to split my transport use for business and personal use, so need online facility or statement – like the Opal card."

Notifications during the journey were also regarded as important to many disability cohorts. This was usually seen as occurring via an App associated with the technology. The types of notifications varied from letting the user know they were on the wrong train, to providing up to date information if changes to their journey occurred, to advising a vision impaired traveller of what platform they needed to go to.

Being able to link with a person at any point on the journey, was considered to be integral to the system working for those who were particularly vulnerable whilst travelling (intellectual disability, blind/vision impaired)

"Phone, with an App – to get special assistance within the app, and also information fed back to me if changes occurred – i.e., notifications."

"So, if your app knows which train you're going to take it can give you a notification hey you're on the wrong train."

"There needs to be a viable backup to whatever technology is adopted so that there is an easy gateway to communicate the issue. Person to person is best."

"When I went to London a few years ago, they had a system where if you wanted to get off at a different stop or something, you would just press a button and there was someone somewhere that you could talk to and I just found that it was a system I wasn't used to, but it was useful and freeing because you could just go "I want to go and see that instead", whatever. Yes, for example I would say I want to get off at this place and then I would change my mind on the way, and you pressed the button. There was some kind of intercom. I don't know if it went through to the driver or someone else on the bus and then they would get out with the ramp and off I would go about my business."

There were many general comments on the ability to eliminate physical infrastructure such as 'gates', the need for back-up systems in case of failure and the need to provide both individual choices alongside of ensuring this was a system that was universal – used not only by those with disability but their 'able bodied' counterparts as well.

"It's the right thing to do to give people more options to use - but let's do it across the board, not just people with disability (mother pushing a pram, person with hands full) Increasing efficiency for everyone."

"We don't want to make decisions that suggests a WHOLE cohort should have a particular type of option, as individuals within any cohort may have individual reasons for using or not using any of the technologies provided."

"There needs to be a back-up system in case the preferred method fails."

"(Removal of gates) - this will mean redesign of a lot of stations in terms of wayfinding."

Table 3 below includes all comments regarding the way participants wanted the platform to work – across the whole of journey, including registration processes (from all four consultation sessions)

Table 3 Whole of journey considerations (how do you want it to work?)

Process	Direct Quotes	Disability	Session
Assistance	It is called IRA and it's an app vision impaired people can subscribe to and you dial in and you get a trained person on the other end of the phone who can give you verbal information like you're walking down a busy street, five doors down is a bank, six doors down is a restaurant, they use your camera phone.	Blind/Vision Impaired	PWD 1
Assistance	Can it have a 'help me' function if I need assistance?	Physical	PWD 2
Assistance	Link with an app – that had the ability to share where you wanted to go or engage assistance if you required. Sends an alert 'I need help' to make human assistance more efficient.	Blind/Vision Impairment	PEAK
Assistance/ Notifications	Phone, with an App – to get special assistance within the app, and also information fed back to me if changes occurred – ie notifications.	Deaf/Hearing Impaired	PEAK
Assistance/ Notifications	It would be good if the App could tell you if it's the wrong train – currently people who are vision impaired plan trips and train their assistance dogs to go to the counter so that they can be told the platform and assisted onto the train	Blind/Vision Impairment	PWD 2
Assistance/ Notifications	So, if your app knows which train you're going to take it can give you a notification hey you're on the wrong train.	Blind/Vision Impaired	PWD 1
Assistance - Press button on device	When I went to London a few years ago, they had a system where if you wanted to get off at a different stop or something, you would just press a button and there was someone somewhere that you could talk to and I just found that it was a system I wasn't used to, but it was useful and freeing because you could just go "I want to go and see that instead", whatever. Yes, for example I would say I want to get off at this place and then I would change my mind on the way, and you pressed the button. There was some kind of intercom. I don't know if it went through to the driver or someone else on the bus and then they would get out with the ramp and off I would go about my business.	Physical	PWD 1
Assistance/Back up	There needs to be a viable backup to whatever technology is adopted so that there is an easy gateway to communicate the issue. Person to person is best.	Deaf/Hearing Impaired	PEAK

Assistance	important to think of human interaction in the process is not as an option or backup but integral to the system	Blind/Vision Impaired	PEAK
Assistance	People that are on location are important for assistance	Cognitive (Stroke)	PEAK
Assistance - Press button on device	token with a button that you could push when you got on/off. If this happened by phone, an automated process good.	Physical	PWD 1
Automation - assistance process	I want it to work such that the system knows I'm on the train and will need assistance at the end of my journey (ie ramp brought to the train) I would want an alert to let them know I'm coming.	Physical	PEAK
Automation	The more automated the service the better for me, one less thing I have to think about.	Psychosocial	PWD 2
Automation	My preference would be just to walk through the gates and not have to do any, any action at all I just like the automated system, where it just picks up on who you are, through your face.	Physical	PWD 1
Automation	It needs to be instant, like a camera, you walk up to a gate you want it to pick up facial features as you go through the gate not have to face a certain way		PWD 2
Automation	Token - No interaction needed – just pass through the gate and it works		PWD 2
Automation	I understand the reason behind it but I would find it clumsy if I had to go on the train, go into the app, and do anything that was going to make the process more involved. Getting on a train at peak hour with a guide dog is enough to contend with without having to do anything extra, except perhaps click on a little button or something like that.	Blind/Vision Impaired	PWD 1
Automation	I would say the point that you made about not needing to get it out and wave it, because that was the initial flag I was thinking about, especially when I'm having mobility issues, having to pull something out, because that is frustrating at the moment just with QR codes going into Woolworths. But if it's a case you don't need to wave it, but it just has to be turned on, that's fine.	Physical	PWD 1
Passwords	It would be good if it could just be downloaded without needing a password protection because I have so many passwords.	Physical	PWD 1
Pre planning	Pre plan a journey via tech (computer, phone etc) or 'tripview' – and that triggers info needed for assistance.	Blind/Vision Impaired	PEAK

100 Points ID	No, that's something we have to do for other points in life, so I think it's something that could be done. Maybe they could just accept a variety of different things so that you've always got something so it's not hard to find what they might need. If it's just 100 points	Physical	PWD 1
100 Points ID	I suppose as far as the setup is concerned for the 100 points of ID with Service New South Wales or the MyGov app, I think by the time you have all that set up, I think most of that is pretty much validated that that's you and you're the correct person using the app. I suppose I'm personally still a little bit resistant to having my complete identity sitting on my phone. Just security purposes and all that stuff.	Physical	PWD 1
Registration - disability specific needs	And I would somehow want it to work if they know I'm on the train, for example, once you have registered, it would be nice if that could also register that I might need assistance when I get to the other end. Because I use a wheelchair, currently you have to tell the station staff where you are going and then you have to hope that they'll remember you when they get there to bring the ramp to get you off the train, for example, and so it would be nice if it did some kind of alert so that you so that they knew that someone with a disability was coming.	Physical	PWD 1
Registration	If it was somewhere local you could go to, that would be fine. (i.e., the Post office)	Cognitive	PWD 1
Registration	Everything that needs to be done needs ethics approval	Psychosocial	PWD 2
Registration	Phone assistance needs to be an option	Blind/Vision impaired	PEAK
Registration	I would need some assistance probably setting it up and that could be a designated phone line where people were going to take the time to talk you through it. That would be really important for me. I have recently had to reset MyGov because I forgot my password and that was a bit of a saga and downloading my COVID certificate and all the rest of it, but it was something I was able to do with somebody really supportive on the other end of the phone.	Physical	PWD 1
Registration	I would suggest that your local council's drop off or up the shop could load the app to your phone for you.	Blind/Vision Impaired	PWD 2
Registration	I want to do it at my local Telstra shop		PWD 2
Registration	Could you turn up in person at Service NSW centres to enrol face to face as an option? This could help people	Physical	EXPERT

	who have difficulty with online or phone facilities. Here a person could assist them to establish an account.		
Registration	I am not sure if I am imagining this or not, but I think the Department of Human Services are looking at a way to provide an app that gives you the Australia Card?		PWD 2
Registration	Encoded info would be good - but what are we registering for, what are we giving consent to?	Blind/Vision Impaired	PEAK
Registration	Some things are automatic. If I have a new app, things are often endorsed automatically, can I register using another pre-registered app?	Deaf/Hearing impaired	PEAK
Registration	One thing we didn't touch on is with any kind of registration process, one of the main issues for a person with a disability, especially those with a permanent disability, is the review function. Would you need to start again in the next 12 months and put in that same paperwork, even though your disability is permanent? Weighing that up with the ability to also gain access for a person with a temporary disability is a concept that needs to be explored in any ticketing arrangement.	Physical	EXPERT
Online registration	I don't know how the signing up would be. I can do that online. That's easy enough to do.	Cognitive	PWD 1
Online registration	Online registration – avoid a process where you have to phone up to set up your card/token	Physical	PEAK
Online registration	Yes, sure. I think with all the COVID stuff, the two apps I would use the most is the Service New South Wales app, which is a four-digit pin to get into. I then had issues even though I went on to my phone to download my COVID certificate, for some reason it was glitching and wasn't loading into Service New South Wales. I then discovered that I could view it through G Pay. So, I know that's Google and not a government app but that seemed to work seamlessly when the Government app didn't work. I suppose the other thing with G Pay is my phone is Android so the Gmail and the identification thing from Google's perspective is already set up on my phone, so it already knew this was me and it was happy to integrate the certificate.	Physical	PWD 1
Online Registration	Many people with physical disability are great with technology, so would manage an online process. But how much personal info would we need to give –	Physical	PEAK

	Could it just be disability specific (ie wheelchair user) rather than I'm "Serena O the wheelchair user"		
Contactless 'key card'	If it is something that looks like a credit card, you will pop it into your wallet the same as you do your EFTPOS card. I know a lot of people's phone holders have slots for cards. So how does the token look? Is it a key change thing or is it the shape of a business card, credit card and it can go in your wallet like everything else?	Physical	PWD 1
Education	No matter what technology T for NSW choose, education will be important – so people understand what is expected. Ensure older people are catered for. Fear will need to be overcome.	Acquired Brain Injury	PEAK
Piloting and education	Piloting in the real environment – trial in different situations, and with different disabilities, education essential	Physical	PEAK
Vibrating or confirmation feature - advantage	I think it would definitely be a good idea, particularly as an override feature if the app wasn't working properly or something. I think it's always good to confirm that you are in fact entering the train and we are all used to the check in, check out process with the QR code, so I think it would be something similar.	Physical	PWD 1
Vibrating or confirmation feature - advantage	Would be good to be able to turn this on/off, or input info once back in front of their 'best technology' at home (maybe later in evening)	Physical	EXPERT
Vibrating or confirmation feature - advantage	This would be good as then my kids wouldn't then get charged full fare when they got off earlier (and forgot to tap off)	Cognitive	PWD 1
Vibrating or confirmation feature	I think also what it needs to have given is not just a beep. It needs to have a totally different sound to all the sounds that we have on our phones, I mean, we know many of them but a lot of them are so similar it's not funny - it needs to have a unique sound.	Psychosocial	PWD 2
Vibrating or confirmation feature	Yeah, just could be something like, even on a token you can sort of see a tick that everything's okay.	Physical	PWD 1
Vibrating or confirmation feature	I have the vibration mode of my phone also switched on so that could be part of it.	Blind/Vision Impaired	PEAK
Vibrating or confirmation feature	Okay, so, Siri – I like the idea that you know you pass through and your phone says something like you have now been issued with a ticket.	Physical	PWD 2
Vibrating or confirmation feature	Once you pass the ticketing gate, it would be a good idea if you know it, you can be acknowledged, and you know as well that it has actually worked. That you have been issued with a ticket.	Blind/Vision Impaired	PEAK

Vibrating or confirmation feature	Deaf people walking through a gate – vibration and/or seeing a light is good to provide confirmation	Deaf/Hearing impaired	PEAK
Vibrating or confirmation feature	There needs to be some indicator, like a beep to indicate that the App is being used	Acquired Brian Injury	PWD 2
Speech	Anything that talks, I'm happy	Blind/Vision Impaired	PWD 2
Payment options	So, you have your top up stations right where you can top up your card. Would your dog be able to find the top up systems, and to go there and identify yourself?	Blind/Vision Impaired	PWD 1
Payment	How do we pay? How do we know we aren't being overcharged, can we get confirmation of payment (i.e., SMS)	Physical	PWD 2
Payment	It would be good to know you could top up still at a newsagent	Acquired Brain Injury	PEAK
Payment	I would want to be able to check my account online, and make sure I wasn't charged incorrectly	Physical	PWD 1
Payment	I need to split my transport use for business and personal use, so need online facility or statement – like the Opal card	Physical	PWD 1
Payment	How do you get payment on any of the options provided? Many people with intellectual disability do not have credit cards, they go to a newsagent to pay cash onto a card. Many are under financial management through Guardianship and have very limited funds available to them.	Cognitive	PEAK
Online account	I think it would be a good idea to be able to track that for the reason that was just shared and also sometimes particularly on Opal card, sometimes some of my travel is work based, not so much with COVID, but before COVID definitely, and then some is private, so you need to itemise it and go, OK, this needs to be covered but my work expenses and these were personal things I was doing. So, I think it is really important to be able to look back at that.	Physical	PWD 1
Examples of good practice	Bendigo Bank App		PWD 2
Examples of good practice	FROGid – good app for storing ID	Acquired Brain Injury	PWD 2
Examples of good practice	Natureblitz		PWD 2

Examples of good practice	Good example of a form – Apple feedback form (sent to you) post an interaction. This is ONLY the checkboxes. No need to type in anything, but this may mean it doesn't ask questions that you may want to answer Have a field that says 'other' and allows you to type in details.	Physical	EXPERT
Examples of good practice	MYGOV ID – but linking to this would have some people very worried about the data they are providing to the government.	Physical	EXPERT
Features	It (token) has to be waterproof, at the very least, to survive at least five seasons if nothing else.	Physical	PWD 2
Integrated Apps	What I'd like to see as far as an app is concerned is that all these different ways of doing things are automatically embedded into the pre-existing public transport apps so we don't have to open any more than we are already using and that the location systems if they're switched on will automatically know that you are at a train station, tram stop, bus station etcetera.	Physical	PWD 1
Integrated Technology	An embedded device with a technology item inside it, or attached to a wheelchair (ie my wheelchair now has a USB device in it)	Physical	PEAK
Near field tech	If using near field tech, (swipe card at a gate) this will indicate you've gone through gate, but doesn't tell you which train you have caught. I think the gateway needs to be on the transport itself (train/bus etc) to capture where you actually travel. This is important for safety info (ie evacuation)	Physical	EXPERT
Tourist/interstate traveler use	You should be able to use the system on a one-off use – they shouldn't have to 'sign up' - like a prepaid use for a day for interstate travelers, tourists, occasional users	Cognitive	EXPERT
Carers/Companions	Currently carers don't have a card themselves, they travel on a companion card for free, how will this work with the new technology?	Deaf/Blind	PEAK
Carers/Companions	How will ticket systems work with other systems such as companion cards? Would a token only allow one person through or would it also allow a companion too?	Blind/Vision Impaired	EXPERT
Lost technology	You need to be able to cancel a lost card/token and get a new one re-issued easily	Cognitive	PWD 2

Backup Systems	There needs to be a backup system in case the preferred method fails	Physical	PWD 2
Elimination of gates	This will mean redesigning a lot of stations in terms of wayfinding	Blind/Vision Impaired	PEAK
Universality	It’s the right thing to do to give people more options to use - but let’s do it across the board, not just people with disability (mother pushing a pram, person with hands full) Increasing efficiency for everyone.	Blind/Vision Impaired	PEAK
Individual Choice	We don’t want to make decisions that suggests a WHOLE cohort should have a particular type of option, as individuals within any cohort may have individual reasons for using or not using any of the technologies provided.	Physical	PEAK
Technology	We acknowledge that the technology is coming but it has to be able to work with all sectors of society. We shouldn't have to try & mould ourselves to "fit".	Deaf/Hearing Impaired	PEAK
Technology	My concern is lag in technology and connectivity	Deaf/Hearing Impaired	PEAK

3. Interaction between technology and human input

The third aspect participants were asked to consider in the consultation process was the interaction between the frictionless technology and where (if at all) participants wanted to have input into the frictionless payment process.

Again, the concept of automation during the actual journey was appealing to most disability cohorts, from automatic recognition and payment on passing through 'gates' to automatic notification of the need for assistance (ie ramp provision.)

Human input was preferred in the initial set up and consent process, in the ability to override any system (turn on/off vibrations) and in being able to check charges made against an individual's account – to ensure accuracy and split for work purposes where necessary.

There was still hesitancy in a fully automated process, and once again some disability groups wanted to know that there would be people on location that were important for assistance at any specific point of the journey. (This need comes about not entirely from a position of being 'anti-technology', but more from a lack of trust in the system, and poor service delivery in the past.)

> *"Just want the option of walking through and not having to do anything."*
>
> *"Automatic information fed back to me if changes occurred – i.e., notifications."*
>
> *"Ability to turn a vibration option on/off."*
>
> *"I want it to work such that the system knows I'm on the train and will need assistance at the end of my journey (ie ramp brought to the train) I would want an alert to let them know I'm coming."*
>
> *"Proper consent needed – signed signature consent."*
>
> *"To be able to retrospectively log in and see your trip and say I didn't get off at Newcastle, I got off at Gosford so you are being charged correctly, I think there's benefit to that."*
>
> *"People that are on location are important for assistance, can't be fully automated."*

Table 4 details additional comments captured on the human vs technology elements of the process.

Table 4 Whole of journey considerations (how do you want it to work?)

Technology/ Process	Direct Quote	Disability	Session
Consent	Proper consent needed – signed signature consent	Psychosocial	PWD 2
Consent	Proper consent is needed, and you need to be able to change consent when you wish.	Blind/Vision Impaired	PEAK
Automation	Token - No interaction needed – just pass through the gate and it works		PWD 2
Automation	It (token) needs to provide instant recognition that the ticket has gone through, like a tick		PWD 2
Automation	I just want the option of walking through and not having to do anything		PWD 2

Automation for assistance process	I want it to work such that the system knows I'm on the train and will need assistance at the end of my journey (ie ramp brought to the train) I would want an alert to let them know I'm coming.	Physical	PEAK
Ticketing	Can it do reversals if there is a mistake? Can it tell us that the charge has been reversed?		PWD 2
Payment	I want to be able to check my charges (like with Opal) so I know I haven't been over charged	Physical	PWD 1
Payment	I want to be able to go online and split my usage by personal and work charges	Physical	PEAK
Payment	To be able to retrospectively log in and see your trip and say I didn't get off at Newcastle, I got off at Gosford so you are being charged correctly, I think there's benefit to that.	Cognitive	PWD 1
Override	it is best to have the option to choose this and switch it on and off		PWD 2
Override	Ability to turn a vibration option on/off.	Deaf/Hearing Impaired	PEAK
Human interaction	People that are on location are important for assistance, can't be fully automated	Acquired Brain injury/Stroke	PEAK
Notifications	Automatic information fed back to me if changes occurred – ie notifications.	Deaf/Hearing Impaired	PEAK
Physical tap on/off	Importantly, you would want to document your trip, like the lady was saying there would be a tap on, tap off post somewhere, on the trip central to Strathfield	Physical	PWD 1

4. How to introduce a frictionless payment system

The final question the groups were asked to consider was that of why a frictionless payment system should be introduced – what did they see as the benefits to having such a system in place and how should it be communicated?

Those with physical disability saw one of the greatest benefits was the ability (assuming it could do so) that once they had registered their disability specific needs against their individual payment profile, they would no longer need to participate in complicated, lengthy pre planning processes, including booking ramps in advance – and could just travel at any time.

Some saw the ability to pre book accessible seating on a journey as a good argument for implementation.

Others saw the data collection gained with frictionless payment processes as highly useful for addressing inclusion – we would be able to show that people with disability are using the system, and that future planning considered infrastructure that was inclusive and accessible. Equally, it was noted that a lack of data was not to be read as people with disability not using the system, but more likely that the particular service wasn't accessible – therefore also needing improvement to allow access for all.

The independence such a system may bring was highly valued by many of the varied disability cohorts. This was through numerous means – automation, and not needing someone with you to assist (with physical tasks), better wayfinding capabilities and improved technology that benefitted those who were blind or had a vision impairment in particular.

Safety was also seen as a good reason for implementing. Knowing who was on transport would enable better evacuation procedures.

There was resistance from those with vision impairment, as for this cohort, concern that they may begin to be charged for using public transport through frictionless payment processes, whereas to date they are provided with free transport.

Caution was also warned, with those from the expert consultation, counselling Transport to look to future proofing any system that they chose – such as it would still be viable in 10 years' time (not at the point of implementation) as technologies were rapidly advancing.

> *"The extra data this system might capture – knowing that as a person with disability you will get the assistance you need. (ie ramp) if your specific data is known."*
>
> *"I would want to provide disability info so that I am identified and get the assistance I need."*
>
> *"Having a 'hook' that sells the idea to an individual (ie booking an accessible seat in advance!)"*
>
> *"Getting the data is hugely important – currently whenever we do policy work, we always get told 'we don't have the data'. This makes it hard to get projects going, as they can't justify need. Getting data will help show need etc. and in the case of PWD – ensure they get access to a universally inclusive system."*
>
> *"Being able to gain good data is important, but we shouldn't look at the fact there is no data in relation to disability, as this may just mean that some infrastructure isn't accessible – and may need to be improved to make it accessible and inclusive."*
>
> *"Giving back mobility & independence to a person with physical disability (not having to ask for assistance)"*
>
> *"Collecting data on who is on transport (including those that travel for free) will mean better safety and evacuation procedures."*
>
> *"Improved wayfinding, targeting staff if needed, seamless transition in/out through, data to inform planning and development."*

Table 5 below provides the direct quotes on arguments for the implementation of a frictionless payment system.

Table 5 Arguments for the implementation of frictionless payment

Arguments for introduction	Direct Quotes	Disability	Session
Notification when needing assistance	I want it to work such that the system knows I'm on the train and will need assistance at the end of my journey (ie ramp brought to the train) I would want an alert to let them know I'm coming.	Physical	PEAK
Notification when needing assistance	Well, I guess, you know, I really got left behind on a train because I didn't notify the guy in that little office thing that I was there and so that he could put the ramp down and then I was like Stop, stop, stop the train. And the grumpy man came and said you should have notified us before this. So, I guess a token could notify the grumpy man in the office that I'm actually there and he needs to, you know, stop drinking his coffee and come out!	Physical	PWD 2
Notification when needing assistance	The extra data this system might capture – knowing that as a person with a disability you will get the assistance you need. (ie ramp) if your specific data is known.	Blind/Vision Impaired	PEAK
Notification when needing assistance	I would want to provide disability info so that I am identified and get the assistance I need.	Blind/Vision Impaired	EXPERT
Notification when needing assistance	I like the idea of knowing that a person is automatically alerted (ie: for a ramp) as soon as their token etc opens a gate – and I didn't have to call beforehand to book would be good. I'd be happy to identify as 'disabled' to automate some of these procedures.	Physical	EXPERT
Data collection	Getting the data is hugely important – currently whenever we do policy work, we always get told 'we don't have the data'. This makes it hard to get projects going, as they can't justify need. Getting data will help show need etc. and in the case of PWD – ensure they get access to a universally inclusive system.	Physical	PEAK
Data collection	Good data is great though – every piece of data we collect that shows people with disability ARE using the network, then this helps build a bigger and more accessible system.	Physical	EXPERT
Data collection	Often the systems think of disability as 'physical disability'. Having data captured would make it easier for myself and family. Anything that Transport NSW can do that assist us to access the community can mean the difference btw being part of the community or not.	Cognitive	PWD 1

Data collection	I think from a selling point, I would probably back up what Geoff was saying about inclusion and I think the more I understand what he is saying about data and my personal data aversion thoughts, but from a planning perspective, I agree with what he was saying	Physical	PWD 1
Data collection	Documentation. Eg Electronic health records. PWD often have extensive health info – this can be easily forgotten, so having it documented would be good. This would also ensure that things were built on strategy and implementation. I really think documenting and storage of information that can be presented to the government is good.	Physical	PWD 1
Data collection	Being able to gain good data is important, but we shouldn't look at the fact there is no data in relation to disability, as this may just mean that some infrastructure isn't accessible – and may need to be improved to make it accessible and inclusive	Physical	PEAK
Future Proof	With any innovation like this, this may have a 10-year life span. I counsel Transport for NSW to think about what would be needed at the time it is implemented and over the 10 years!	Physical	EXPERT
Forcing Payment	Lot of resistance from people with vision impairment as they haven't had to pay in the past, and this may then require payment.	Blind/Vision Impaired	PEAK
Automation	Basically, like there shouldn't be any interaction, you just pass through the gates and it should recognise you	Blind/Vision Impaired	PWD 2
Independence	Creates more independence. Yes, so any arguments that they could use, anything that's going to make our lives easier.	Physical	PEAK
Independence	Giving back mobility & independence to a person with physical disability (not having to ask for assistance)	Physical	PEAK
Independence	Independence. You need someone to open the gate for you at the moment, you won't need that	Physical	PWD 2
Independence	So, anything that Transport New South Wales can do that assists us to be able to access the community can really mean the difference between being part of the community or not.	Cognitive	PWD 1
Inclusion	I think the more inclusive and easier things are that are public space, which public transport is, that to me is probably the bestselling angle of it, which is the inclusion and trying to make it work for everyone so there is less of that divide between an able-bodied person and someone who's disabled because it's just going to work for everyone.	Cognitive	PWD 1
Allocated Seating	Having a 'hook' that sells the idea to an individual (i.e., booking an accessible seat in advance!)	Physical	EXPERT

Improved wayfinding	improved wayfinding, targeting staff if needed, seamless transition in/out through, data to inform planning and development	Blind/Vision Impaired	PEAK
Safety	Collecting data on who is on transport (including those that travel for free) will mean better safety and evacuation procedures	Physical	EXPERT
Technology	the opening up of technology that benefits people who are blind/low vision.	Blind/Vision Impaired	PEAK

Evaluation criteria related to frictionless technologies for people with disability

In Table 6 through Table 9 below, all of the insights provided across the focus groups and consultations have been aggregated against recurring criteria.

Table 6 Issues and opportunities when considering frictionless transport options for people with disabilities

Explanatory Note: An 'X' in any box in Tables 6-9 indicates that this issue or requirement was raised by the cohort listed. Numerous 'X's across the same criteria is an indication that the need or issue was relevant to more than a single disability cohort.

Phone – Criteria	Ref #	Consideration	Physical	Cognitive	Psychosocial	Visual	Auditory
Simplicity	1	Simple, technology already understood	X		X	X	X
Peace of Mind	2	Beeping Sound to indicate payment				X	
	3	Vibrate to indicate payment	X			X	X
	4	Light or 'tick' to indicate payment					X
Connectivity	5	Link with Apple watch				X	
Handsfree	6	Must work without being held/handled	X	X	X	X	X
Reliability	7	Disadvantage – No connectivity (blackspot, battery life, no credit)	X	X	X	X	X
Equitable Use	8	Disadvantage – unaffordable for some cohorts		X			
Token – Criteria	**Ref #**	**Consideration**	**Physical**	**Cognitive**	**Psychosocial**	**Visual**	**Auditory**
Simplicity	9	No technology or other requirements to use	X	X	X	X	X
Peace of Mind	10	Vibrate to indicate payment	X			X	X
	11	Light or 'tick' to indicate payment					X
Convenience	12	Worn as 'jewellery – wristband, necklace"	X				
	13	Attached to guide dog harness				X	

	14	Credit card (chip) option carried in wallet	X				
Handsfree	15	Must work without being held/handled	X		X	X	X
Connectivity	16	Ability to feedback to phone				X	
	17	Button to press for assistance	X	X		X	
Reliability	18	Disadvantage – additional piece of technology to carry/lose	X	X	X		
	19	Disadvantage – false readings (multiple charges)	X	X			
Biometrics – Criteria	**Ref #**	**Consideration**	**Physical**	**Cognitive**	**Psychosocial**	**Visual**	**Auditory**
Simplicity	20	No technology or other requirements to use	X		X	X	X
Convenience	21	No additional physical equipment to carry	X	X	X	X	X
Equitable Use	22	Works for all everyone equally	X	X	X	X	X
	23	Disadvantage – issues for those with facial disfigurement/conditions with continual movement	X	X			X
Privacy	24	Disadvantage – many people opposed to providing level of personal data required	X	X	X	X	X
Wayfinding – Criteria	**Ref #**	**Consideration**	**Physical**	**Cognitive**	**Psychosocial**	**Visual**	**Auditory**
Independence	25	Ability to navigate environment without assistance	X			X	
Convenience	26	Disadvantage – additional equipment to carry	X	X		X	
	27	Disadvantage - Sensory overload	X	X			
Simplicity	28	Disadvantage – would need training to understand use		X			

All technologies - Criteria	Ref #	Consideration	Physical	Cognitive	Psychosocial	Visual	Auditory
Assistance	29	Ability to call on human assistance in any process	X	X	X	X	X
Companion Travel	30	Issue of free travel for companion card holder (carer)	X	X		X	
Handsfree	31	Does not require any physical undertaking	X	X	X	X	X

Whole of Journey requirements

Table 7 How do you want frictionless transport options to work when considering the whole of journey requirements (including set up/registration processes)?

Process	Ref #	Consideration	Physical	Cognitive	Psychosocial	Visual	Auditory
Registration	32	Ability to choose registration option to suit needs (online, in person, via phone)	X	X	X	X	X
	33	Online via previously registered services (Service NSW, Google, Apple, MyGov	X	X			X
	34	In person – Post Office, Telstra shop, local council, Service NSW centre		X		X	
	35	Phone assistance	X	X		X	
	36	Previous recognition of 100 points ID	X				
	37	Ability to include disability specific requirements (where it automates assistance on any journey)	X				
Education	38	Education of any new system and piloting to test functionality	X	X			
Assistance	39	Help function when needed (button or intercom)	X	X		X	X
	40	Link to human assistance	X	X	X	X	X

Automation	41	Automatically registers need for assistance (ramp for boarding)	X				
	42	No physical interaction during journey	X		X	X	
Notification	43	Provide notice of changes to trip					X
	44	Advise if on wrong transport				X	
	45	Confirmation of payment (vibration/light/sound)	X	X	X	X	X
Payment	46	Online account to track payment	X	X			
	47	Ability to split payments between personal and work use	X				
	48	Top up stations				X	
	49	Option suitable for those with limited funds/financial management		X			
Integration	50	With transport Apps	X				
	51	With assistive technologies	X				
Technology	52	Must work for all					X
	53	No ‘lag’					X
	54	Easy ability to cancel (card/token) when lost		X			
	55	Elimination of physical ‘gates’	X			X	
	56	Fail safes when one technology doesn’t work	X				
Flexibility/Choice	57	Provides personal choice	X				
	58	Used by those with & without disability	X			X	

Interaction between Technology and Human input

Table 8 Interaction between technology and human input

Process	Ref #	Consideration	Physical	Cognitive	Psychosocial	Visual	Auditory
Human							
Consent	59	Signed consent required to use system			X		
	60	Ability to change consent at any time				X	
Payment	61	Ability to check charges	X	X		X	
Assistance	62	Human interaction available at any point	X	X		X	X
Override	63	Ability to turn on/off	X				X
Technology							
Automation	64	No physical interaction btw person and technology (when using transport)	X		X	X	X
	65	Instant recognition of payment (no matter what technology used)	X	X	X	X	X
	66	Automatic provision of access assistance (ramp/guidance)	X			X	
	67	Notifications (changes, services)					X

Arguments for introducing frictionless payment technologies

Table 9 Arguments for introduction of frictionless payment technologies

Criteria	Ref #	Consideration	Physical	Cognitive	Psychosocial	Visual	Auditory
Safety	68	Ability to know who is on transport and provide appropriate evacuation processes where needed	X			X	X

Independence	69	Provides ability for independent travel	X	X		X	
Prioritisation	70	Ability to pre book accessible seating for journey	X			X	
Automation	71	No need to have to undertake a physical process (tap on/off)	X			X	
	72	Automatic provision of assistance when need i.e., ramp access (no need to pre plan/book or call)	X				
Data Collection	73	Ability to use data to show need, improve accessible infrastructure/processes	X	X			
	74	Future proof system based on need	X				
Technology	75	Better technology that assists independence those with low vision				X	
	76	Improved wayfinding				X	
Inclusion	77	Ensuring ONE system for all		X			

Preparatory Materials – People with Disability Consultations

A - Information Session:

Thank you for participating in this review of emerging ticketing technologies for Transport for New South Wales. We hope to learn what the challenges and opportunities new technologies for ticketing of public transport are for PWD.

TfNSW, iMOVE and The Centre for Technology Infusion are soliciting feedback, in particular from people with disability and their representative organisations, with regards to the following:
Many customers with disability face barriers while accessing and using Transport for NSW's ticketing system when travelling on the network. Where a customer is unable to use the ticketing system, Transport for NSW currently offers an alternative pass that provides free travel. However, difficulties with this arrangement can sometimes occur if staff are not present to assist pass holders with opening the gates. This also means that there is no record of pass holders using public transport, which is important for capacity planning, real time information about the availability of priority seats, emergency situations, etc.
There are a number of technologies that can help automatically capture entry and exit of the platform or a vehicle. The purpose of this research program is to explore new and emerging technologies that can offer a true frictionless ticketing experience to transport customers across multiple modes. 'Frictionless' payment means that Public Transport can be used with little or, ideally, no effort. For example, in the USA, in some stores you can just pick up products from the shelve, walk out of the supermarket and the payment is automatically done (if you have the right app and are signed up).
The research outcome of this project will clarify what are the key strengths and challenges of new and emerging frictionless ticketing technologies. Outcomes will explore technology options that will ease connected transport journeys across multiple modes including interchanges. As a result of this research program, TfNSW will aim to co-design new research trials that will assess how frictionless ticketing propositions can truly enhance the public transport customer experience.

Today's session is to provide you with a brief on what is happening in the frictionless payment space, and to explain the four types of frictionless payment that we will review in greater depth in the later consultation session. The purpose is to inform you of what can be expected so that you think about the challenges and opportunities that arise with these new technologies for people with disability.

An overview of technology trends

Please note that, **it is not required to understand the below technologies at all,** to provide feedback on this paper. We are proving it by way of context.
Without going into too much technical details, a number of trends in technology are now enabling ticketing to become even easier than tapping on and off and become potentially completely automatic. They include trends that have become buzz words, but in this case really do make a difference.

1: Location positioning and time
It was not long ago that you'd be reliant on a map, to find out how to get somewhere new. Now online mapping services do that and guide you in real time. Autonomous vehicles, smart factories, drones have further driven the need to determine the exact position of things. Hence, a number of connectivity technologies have been trying to improve themselves to deliver more accurate positioning. This means that instead of placing gates at the railway station, you could now have a very precise virtual gate, or, the real gate automatically opens when you walk through it.
2: Speed, low latency

Safety solutions, for instance in mining and car crash prevention, require things to communicate with other things in milliseconds. Today, real time data processing and communications are designed to do that, so the time between detection (of for instance a person) and reaction (for instance opening a gate) can be ultra-short.

3: Processing power and miniaturisation

The ability of processing complex data sets by tiny chip sets is bringing new opportunities to, for instance, medical devices, hearing aids, etc. CSIRO is studying bees by placing a very small, but fully capable micro-chip on the back of bee. What a smart phone can do now, would require a very large computer only a decade ago. Your phone can accurately execute complex tasks. It has become the proverbial Swiss army knife as it can perform so many functions.

4: Real time big data analysis

The same processing power can be applied to gigantic data sets, for instance to manage traffic flows, traffic lights, etc. The programs that analyse these very large data sets can find a needle in a haystack in seconds. This means that Public Transport journeys can be improved, even for very small groups of public transport users.

5: Low power consumption battery technology

The need to have things communicate with other things has driven the development of low power consuming connectivity, as it would be impossible to change or charge batteries or have everything connected to a power grid. This means for instance that an app using GPS or Bluetooth would no longer drain your smart phone battery as fast as it would years ago. At the same time batteries are getting smaller and better; Batteries last longer and charge faster.

6: Encryption, data security and privacy

The industry has also responded to an increasing need for security. They have made it harder to 'eavesdrop' on signals. Famously, Facebook's messenger is now 'end-to-end' encrypted, and two factor authentication (e.g., entering a password on one device, and then a confirmation code on another) is now common, for instance to access your MyHealth records. Governments have been actively working on regulation that prescribes how private data needs to be handled, and in response, so called 'tokenisation' solutions, which separate personal data from the rest, have grown into a sizable industry itself.

Ticketing technology: 4 options

Does that mean that all the problems are solved? No, but a solution is within reach and in this process, we would like to hear your feedback on the four options below.

Table 10 Four options

	Smart phone	**Wearable token**	**Biometrics**	**Assistive technologies**
What is it	An app on your smart phone or your smart watch.	A small device, like a key chain or armband. (It can take many forms)	A device on the train station or bus stop that can read a biometric characteristic. (facial, fingerprint, voice, etc.)	A body camera for people with disability that 'looks out' for you and guides you.
What does it do	It will 'tap-on' and 'tap-off' for you automatically.	It will 'tap-on' and 'tap-off' for you automatically.	It will 'tap-on' and 'tap-off' for you automatically	It will 'tap-on' and 'tap-off' for you automatically.

B: Consultation questions
In addressing the questions we will tackle today, we would like to understand which solution works best for whom. The outcome of this process may lead to the consideration of more than solution.
Given your disability, what would be the pros and the cons of each of the four options.

Thinking of the options that you prefer, can you describe your ideal user experience, how you would want it to work. (Please try and be as specific as possible. E.g., Instead of "the phone app needs to be accessible" it would be desirable to have more details, like "It would be good if it could be just as accessible as this app (name of app) because their voice commands really work well, and it is really easy to get to what you want in the app.)
You can think of:

- The device itself
- The experience on the bus or train station
- Assume for a moment that there are NO technical limitations
- Human input vs. fully automatic
- The technology options described can be fully automatic, you don't need to do anything. However, these options could also be less automated, and for instance ask you to tap on your phone, or tap on by clicking a button on your token

Can you please let us know how you'd feel if for your preferred option there would an option to 'tap on'? For example: You walk through the virtual gate, and your phone would show message asking you to tap on. Or, in case of a token, it may vibrate and ask you to click a button on the token.

What are the most convincing arguments for technical this technology, e.g.,

- You would have less issues at the gate of a railway station, or entering a bus or tram
- You would have less issues with being registered because it would be digital, not paper based
- The operator will have a record of pass holders using public transport, which is important for capacity planning, emergency situations
- The operator can start to personalise your journey, e.g., provide real time information about the availability of priority seats, automatically roll out a ramp, warn you that you are entering a different train than the one you planned for, etc. (Note, these are examples)

For the sake of the discussion, assume that they are all technically flawless, and they work in all public transport modalities, bus, train, ferry, etc.

Ethics forms (example: AFDO – Experts)

Expression of Interest

The Australian Federation of Disability Organisations (AFDO) is a **Disabled People's Organisation (DPO)**. We are a cross-disability representative organisation, and the national voice representing people with disability in Australia.

We are currently supporting a research initiative by the Centre for Technology Infusion (CTI) at La Trobe University, on behalf of Transport for New South Wales.

PURPOSE

AFDO is seeking expressions of interest from community members that would like to be a part of a focus group that will explore the following questions, challenges and opportunities.

Problem:
Many customers with disability face barriers to accessing and using Transport for NSW's ticketing system when travelling on the network. Where a customer is unable to use the ticketing system, Transport for NSW currently offers

an alternative pass that provides free travel. However, difficulties with this arrangement can sometimes occur if staff are not present to assist pass holders with opening gates. This also means that there is no record of pass holders using public transport, which is important for capacity planning, real time information about the availability of priority seats, emergency situations, etc.

There are a number of technologies that can help automatically capture entry and exit of the platform or a vehicle. The purpose of this research program is to explore new and emerging technologies that can offer a true frictionless ticketing experience to transport customers across multiple modes. 'Frictionless' means that Public Transport can be used with little or, ideally, no effort. For example, just as in the USA, in some stores you can just pick up products from the shelve walk out the supermarket and the ticketing is automatically done (if you have the right app and are signed up).

The research outcome will clarify what are the key strengths and challenges of new and emerging frictionless ticketing technologies. Outcomes will explore technology options that will ease connected transport journeys across multiple modes including interchanges. As a result of this research program, TfNSW will aim to co-design new research trials that will assess how frictionless ticketing propositions can truly enhance the public transport customer experience

The focus groups will be conducted over two phases:

Phase 1: We will inform you about frictionless ticketing technologies in an online information session.

Phase 2: An online group discussion about:

1. The pros and cons of the options
2. The best way to trial the options that will eventually be shortlisted

Taking part in this research study is optional and we respect your right to privacy and as such all information will be de-identified.

REMUNERATION

Remuneration will be XXXX per hour (inc GST) deposited onto a debit card, which will be posted after delivery of services. The two sessions are anticipated to run for approximately 2 hours with a short break included. We will send you pre-reading materials which will be discussed during the meetings.

SELECTION CRITERIA

Selection criteria are as follows.

- Lived experience of disability
- Be actively and/or professionally involved in this, or similar transport accessibility issues
- Experience accessing and utilising public transport along with transport services, or,
- Not using public transport specifically due to ticketing issues (problems with tapping on, or tapping off)
- At least 50% of respondents need to be a resident of NSW
- Availability in the first two weeks of November (Exact dates to be confirmed)
- Ability to attend meeting online (using an online meeting platform such as Zoom)

ACCESSIBILITY

The project will cover accessibility requirements for participants, including support people.

APPLICATIONS

If you are interested in being a part of this focus group, we encourage you to register your interest by sending an email to Jim.Valavanis@afdo.org.au at the Australian Federation of Disability Organisations and include a brief background along with your contact details. We would also appreciate it if you kept your response and initial proposals confidential.

This research has been reviewed and approved by The La Trobe University Human Research Ethics Committee. If you have any complaints or concerns about the research study please email humanethics@latrobe.edu.au or phone +61 3 9479 1443 quoting the following number HEC21322].

Expressions of interest close [insert date].

< to be sent upon confirmation of interest >

Frictionless ticketing and public transport The research is being carried out by the following researchers:		
Role	Name	Organisation
Peak body representatives and reporting	Serena Williams	CFDN
PWD recruitment and focus group management	Jim Valivanis	AFDO
Overall project responsible	Erik van Vulpen	La Trobe
Research funder	This research is funded by TfNSW, La Trobe University, by iMOVE CRC and supported by the Cooperative Research Centres program, an Australian Government initiative.	

Participation Information Statement

Thank you for your expression of interest in participating in the study about autonomous vehicles and public transport for people with disability

Please read the below information and upon reading confirm your participation.

What is the study about?

Many customers with disability face barriers to accessing and using Transport for NSW's ticketing system when travelling on the network. Where a customer is unable to use the ticketing system, Transport for NSW currently offers an alternative pass that provides free travel. However, difficulties with this arrangement can sometimes occur if staff are not present to assist pass holders with opening gates. This also means that there is no record of pass holders using public transport, which is important for capacity planning, real time information about the availability of priority seats, emergency situations, etc.

There are a number of technologies that can help automatically capture entry and exit of the platform or a vehicle. The purpose of this research program is to explore new and emerging technologies that can offer a true frictionless ticketing experience to transport customers across multiple modes. 'Frictionless' means that Public Transport can be

used with little or, ideally, no effort. For example, just as in the USA, in some stores you can just pick up products from the shelve walk out the supermarket and the payment is automatically done (if you have the right app and are signed up).

The research outcome will clarify what are the key strengths and challenges of new and emerging frictionless ticketing technologies. Outcomes will explore technology options that will ease connected transport journeys across multiple modes including interchanges. As a result of this research program, TfNSW will aim to co-design new research trials that will assess how frictionless ticketing propositions can truly enhance the public transport customer experience

1. **Do I have to participate?**

Being part of this study is voluntary. If you want to be part of the study, we ask that you read the information below carefully and ask us any questions.

You can read the information below and decide at the end if you do not want to participate. If you decide not to participate this won't affect your relationship with La Trobe University or any other listed organisation.

2. **Who is being asked to participate?**

You have been asked to participate because you

- have Lived experience of disability
  - Be actively and/or professionally involved in this, or similar transport accessibility issues
  - have experience accessing and utilising public transport along with transport services
  - are able to use Public Transport without a carer, OR, you wish you could use Public Transport but you are unbale to do that because 'tapping on and off" is a specific key hurdle
  - are available in November 2021
  - have previous experience of participating in focus groups
  - are able to attend meeting online (using an online meeting platform such as Zoom)

3. **What will I be asked to do?**

You will be asked to participate in two sessions. We will contact you by phone to invite you to an information session and check your understanding of the project, your capacity to participate and any risk mitigation.

The focus groups will then be conducted over two phases:

- Session 1: We will inform you about the ticketing technology options so that you have some time to digest and ask questions

- Session 2: We will discuss if and how each of these ticketing technologies can make public transport more accessible

4. **What are the benefits?**

The benefit of you taking part in this study is that you can influence how public transport organisations let you pay or ensure thy know you are on the bus/train/tram.

5. **What are the risks?**

With any study there are (1) risks we know about, (2) risks we don't know about and (3) risks we don't expect. If you experience something that you aren't sure about, please contact us immediately so we can discuss the best way to manage your concerns.

Name/Organisation	Position	Telephone	Email
Jim Valavanis - AFDO	Manager – Business Development & Engagement		

We do not foresee any risks associated with this study.

6. What will happen to information about me?

We will **collect** information about you in ways that initially will capture who you are as we will record the online meetings. Immediately after that, in the notes and reports, information and your comments will be de-identified, which means that we will not report and publicise any information that can be tracked to you.

We will securely **store** the videos in a way that reveals who you are, all other materials will be de-identified.

We will **publish** information about you in ways that will not identify you in any publication from this study.

We will **keep** your information for 5 years after the project is completed. After this time, we will destroy all of your data.

The storage, transfer and destruction of your data will be undertaken in accordance with the Research Data Management Policy https://policies.latrobe.edu.au/document/view.php?id=106/.

The personal information you provide will be handled in accordance with applicable privacy laws, any health information collected will be handled in accordance with the Health Records Act 2001 (Vic). Subject to any exceptions in relevant laws, you have the right to access and correct your personal information by contacting the research team.

7. Will I hear about the results of the study?

We will let you know about the results of the study by the end of the study in Feb 2022.

8. What if I change my mind?

You can choose to no longer be part of the study at any time until [four weeks] following the collection of your data. You can let us know by:

1. Completing the 'Withdrawal of Consent Form' (provided at the end of this document);
2. Calling us; or
3. Emailing us

Your decision to withdraw at any point will **not** affect your relationship with La Trobe University or any other organisation listed.

When you withdraw, we will stop asking you for information. Any identifiable information about you will be withdrawn from the research study. However, once the results have been analysed, we can only withdraw information, such as your name and contact details. If results haven't been analysed you can choose if we use those results or not.

9. Who can I contact for questions or want more information?

If you would like to speak to us, please use the contact details below:

Name/Organisation	Position	Telephone	Email
	Manager – Business Development & Engagement		
Erik van Vulpen	Deputy Director – Centre for Technology Infusion		

10. What if I have a complaint?

If you have a complaint about any part of this study, please contact:

Ethics Reference Number	Position	Telephone	Email
HEC21322	Senior Research Ethics Officer	+61 3 9479 1443	humanethics@latrobe.edu.au

Consent Form – Declaration by Participant

I (the participant) have read (or, where appropriate, have had read to me) and understood the participant information statement, and any questions have been answered to my satisfaction. I agree to participate in the study, I know I can withdraw at any time until [four weeks] following the collection of my data. I agree information provided by me or with my permission during the project may be included in a thesis, presentation and published in journals on the condition that I cannot be identified.

I would like my information collected for this research study to be:

☐Only used for this specific study;

☐I agree to have my interview audio recorded

☐I agree to have my interview video recorded

☐I would like to receive a copy of the results via email or post. I have provided my details below and ask that they only be used for this purpose and not stored with my information or for future contact.

Name	**Email (optional)**	**Postal address (optional)**

Participant Signature

☐I have received a signed copy of the Participant Information Statement and Consent Form to keep

Participant's printed name	
Participant's signature	
Date	

Declaration by Researcher

☐ I have given a verbal explanation of the study, what it involves, and the risks and I believe the participant has understood;

☐ I am a person qualified to explain the study, the risks and answer questions

Researcher's printed name	
Researcher's signature	
Date	

* All parties must sign and date their own signature

Withdrawal of Consent

I wish to withdraw my consent to participate in this study. I understand withdrawal will not affect my relationship with La Trobe University of any other organisation or professionals listed in the Participant Information Statement. I understand the researchers cannot withdraw my information once it has been analysed, and/or collected as part of a focus group.

I understand my information will be withdrawn as outlined below:

- ✓ Any identifiable information about me will be withdrawn from the study
- ✓ The researchers will withdraw my contact details so I cannot be contacted by them in the future studies
- ✓ The researchers cannot withdraw my information once it has been analysed, and/or collected as part of a focus group

I would like my already collected and unanalysed data

Destroyed and not used for any analysis

☐ Used for analysis

Participant Signature

Participant's printed name	
Participant's signature	
Date	

Please forward this form to:

CI Name	
Email	
Phone	

2: Transport operator interviews report

Introduction

This report provides a deidentified account of different transport customer service operators to understand more about the challenges and opportunities that Frictionless Payment Technologies represent, and how these technologies may impact their business interest.

Set up

In the context of the Frictionless Ticketing for Public Transport project, The Centre for Technology Infusion undertook a series of six online workshops with transport operators and customer service providers.

In total 13 participants, representing different transport sectors including Ferry, Metro, Bus and Train provided their feedback and opinions on the suggested technology.

Each consultation was conducted online via Zoom and ran for 1 – 1.5 hour for each session.

13 senior operator representatives participated in the workshops, including Sydney's Airport Train, Transdev Australasia, Customer Experience, Sydney Trains, Sydney Metro, Transdev, operator of Sydney Ferries, Transdev, operator of Sydney Ferries.

Workshop agenda

1. La Trobe presented a synopsis of the work done to date inc. the technology options for frictionless ticketing
2. Discussion within the six interviews was broken down into three main topics:
   - Which evaluation criteria are the most important in your perspective?
   - What are the pros and cons of each of the four options?
   - What are the other considerations (data, added value services, etc.)

First reactions

The first reactions were mostly positive. Operators confirmed the benefits of frictionless technologies – and added that they would like it to be for everyone not only for people with a disability.

> '*The whole concept of scalability of the technology is the most important thing. The benefit should be for everybody. 38 thousand people a day through Mascot before COVID. Just a split second in time savings for people moving through the gate makes a very big difference.'*
>
> *'What we look for in a ticketing system, for example in contactless payment, is to make things more streamlined and efficient and keep the people moving, without stopping. There is no need for queuing for paper tickets. Contactless is very good as is reliable, quick and completely disengaging from the customers and it has revolutionised our business. They can move though without stopping – which is the key to it all.'*
>
> *'If the customers could move that wide gate and pay, we wouldn't need to maintain the mechanical gates. I could see a world without those gates where we are not welded by mechanical devices'*
>
> *'For fundamental customer service, we like to be proactive.'*
>
> *'It makes it more inviting and welcoming if it is not completely gated. It makes the journey much easier if the passenger, for example, is running for the service. From a convenience aspect, that's a really good selling point. The biggest thing we see is privacy. If we can prove that it is improving the journey while maintaining privacy, then the public will like it.'*
>
> *'The whole expression of frictionless / contactless is to allow more and more travellers to adapt towards this new system / term. This psychological change is required to get people onboard from an interstate perspective. Put the idea that not all people are living in Sydney. We shouldn't make people feel like we are interrupting him and equally, he is interrupting the workers.'*
>
> *'Having to look for phone or card is always a little stressful, in particular when you are rushing to make it to a particular train.'*

However, almost all were also quick to acknowledge the need to make public transport more accessible for People with Disability:

> *'I went to the human right commission and explained the case where a PWD traveller was forgotten on the train. The person was played like a ping pong ball after she missed a station. It was not fun for me to explain why. Our existing system is only as good as human intervention. The more we take human error out of it, it should be better. They want to use the technology, but they lack the confidence in our technology. The whole essence of discrimination legislation is equivalence. The PWD wants to be independent. I think a solution that allow us to take out those horrible mechanical gates is worth pursuing but it's not just only one solution.'*
>
> *'I think people with disability deserve a solution without human dependency. The essence of non-discrimination legislation is equivalence.'*
>
> *'Another thing is accessibility. Looking after accessibility is good, but to do it exclusively might be a bad call. The PWD wants independence. Just being conscious to improve accessibility may lead to misdirection towards the PWD. It should be a solution for all.'*
>
> *'There should always be staff present at the station and ready to assist, but if they are not glued to the gate that is better.'*

Technology preference: Options

There was no preference for either technology, under the assumption that neither of them influences throughput and are all equally reliable. Most mentioned that this will likely incorporate a mix of technologies to cater to various needs.

> *'The consistency across the network may not be solved by only one solution. Consider whether that technology works for the specific mode.'*

Of all stakeholders, including internal at Transport, the operators seem to be the most comfortable with facial recognition:

> *'For biometric, that would be a huge benefit to buses. What happens if the passenger cannot pay for the fare on the bus?' If the technology can automatically recognise the passenger, that would be great. Would that be similar in a bus operation where one is the exit and the other is the entrance?'*

> *'If we could use facial recognition only for one gate and leave the rest for everyone else, so it is optional to use it, would that be good? Yes, that would be really good. If we have split the section half, maybe people who do not prefer facial recognition and go to one of the given sections? I guess we will always get resistance and once they see how the world moves and get onboard, they will probably understand soon after. I am all for frictionless ticketing and I believe this is the future rather than trying to catch up with the rest of the world. The key points for us are fare evasion, throughput and the customer experience.'*

With regards to the phone option, reliability and loss of connection was raised as an issue.

> *'In the network, there are 4 to 5 black spots around here and there. If you are looking at a solution on board, you will most likely experience the black spots.'*

> *'As it is today, the GPS and communication between card reader is often lost, which leads to the bus being not able to be tracked.'*

> *'The GPS and communication between card reader which leads to the bus being not able to be tracked. The major issue is people not having a card or not having sufficient fund.'*

Easily losing the token was the main concern of that option:

> *'For wearable token, what to do if we lose the token? How do we track the balance?'*

Integration wayfinding was mentioned even before the idea was introduced:

> *'What we love to see, a development app, to use wayfinding technology within the station for people with vision impairment.'*

Evaluation criteria: What is important to the operators?

In order to allow for a deeper understanding of the proposed technology solutions, various aspects of the solutions were discussed in order to clarify any misconception and to ask the question: how would you want it to work?
There are many factors to be considered when applying the suggested ticketing system towards different operating environment. The complexity and necessity of the suggested solutions needed to accommodate all kinds of travellers and allow for a seamless experience. The operators raised several issues regarding the fundamental architecture of the proposed solution.

The most important for operators was its reliability and having a backup:

> *'We will always go for usability'*
>
> *'It definitely should not create more work'.*
>
> *'A lot of people rushing to the gate, then having to dig up their pass. What does need to be considered is backups – at the moment friction comes from having no balance, forgotten or expired cards or a phone running out of battery. Of the will lead to a fine if an officer encounters these cases. So, frictionless technologies should try and deal with that too. Public Transport is often stressful, getting there in time, so if any of that stress can be reduced it's a good thing.'*

Fare evasion control:

> *'Fare evasion rates are more prevalent. The gates themselves are proved to be something that assure revenue protection as it minimises the evaders to walk through. '*
>
> *'I think the big one for me is fare compliance. If you would implement some of these new technologies, what would be the transition process?'*
>
> *'As an option for the future, highlight that transport cares very much about revenue loss.'*

The ability to manage crowds:

> *'You need to consider event modes, for example in the Olympic Park where you don't want a surge of people coming in.'*
>
> *'We use the gates to slow people down. We don't want people to move through the station too quickly. The whole concept of not having gate, we would need to rethink how the operation would work. There will be unintended consequences.'*

With regards to public adoption, privacy and security are key:

> *'The biggest thing we see is privacy. If we can prove that it is improving the journey while maintaining privacy, then the public will like it.'*
>
> *'My other question is about security. How would the general public see that as the big brother is now tracking the movement of the public?'*

A fare evasion policy and solution needed to be available:

> *'If we try to follow what they are doing with bag tags, it has been raised a few times. It is interesting with odd people saying the battery ran out. So often, battery assisted device may lead to excuse regarding battery. '*
>
> *'If you are talking about gated system, and heading towards a non-gated solution, how that would work? If you didn't tap on from an ungated station, how can that be solved? How much leakage is there for this solution?'*
>
> *'System is used to track registered Opal card. However, we cannot track unregistered Opal card.'*
>
> *'What if the passenger simply turns off the phone?'*

Extensive education and communication would be required to help travellers and operators who may struggle to adapt towards the proposed solutions.

> *'If they are not aware of the system, how do we help them go through.'*

Registration for new customers, managing companions and groups and consistency between states was mentioned:

> *'The challenge is to resolve the top 1% of the difficulties. The issue of companion cards which is sometimes difficult for the company. There seems to be a lot of policy issue such as who gets free travel and who does not. This is a broader challenge working out who is who. The issue of companion traveller sometimes confuses us. most often, we let people through the side gate. People identify they are a companion and we let them go through the side gate. Generally, it's the frustration for the traveller. We have had situations where the staff is at the office and the wheelchair user is waiting on the platform. Things can go wrong.*
>
> *The other thing is, when running a business, each state has their own ticketing system. Somehow in the future, if particularly NSW, Qld and Victoria could have the same ticket technology, then that would be so beneficial for the interstate traveller, especially for the pensioner market as you cannot simply get a pensioner opal card from train stations, you need to do that on line*.
>
> *'We are trying to adopt apps to help people navigate around the stations. We are also looking at system where a person can purchase multiple tickets for a group. For example, kids don't have credit cards and you have to buy multiple opal cards which is not very handy. It's a matter of how to get the concept to work even if the concept has been hypothesised. With airport lines you get a lot of travellers who don't speak English.'*

The prospect of potentially not having gates and always be 'open' triggered some concerns:

> *'The whole concept of not having a gate, we would need to rethink how the operation would work. There will be unintended consequences.'*

Hardware and mechanical design suggestions:

> *'The biggest problem is the equipment on the bus. They knew the bus equipment will never be accurate. It goes over humps and gets really battered. If you want to put technology on bus, where it uses 3G, all the plans you had would be nullified.'*
>
> *'Physical gate needs to be installed carefully to not cause injuries. Bear in mind what you are putting in will end the era of legacy gate. The new gates should make reference the speed and technology of the gates.'*

Extended benefits and Data requirement for future technology

The third aspects participants were asked to consider in the interview process was the requirement of data produced via the suggested ticketing system and consider whether the data collection can improve the travelling experience.

At the moment, none of the operators could tell how many People with Disability were using their services.

Operators could easily see how real time notifications of the presence of People with Disability could help them improve their services, but that would require significant operational and system preparation.

> *'Yes, we are definitely interested in that. (Disability passenger data) If we can improve on what we got, meet the customers at the initial stage, easier access to transport, then technically this is beneficial while collecting useful data.'*

> *'Imagine a PWD enters the station and automatically sends the officer an alert where they should be pay attention and offer any sort of help when required. For fundamental customer service, we like to be proactive.'*

> *'Is there part of the system that can notify the station for support towards people with disability? The last thing is not knowing a wheelchair user is waiting on the train trying to get off. I'd certainly put this matter in the mix. We need prior notification of people arriving who may need our assistance.'*

> *'We have heard all sorts of things go wrong. The challenge is to look at what level of disability and how much support the people need.'*

> *'Does the system notify someone and tell the officer to approach someone. What level of resource does the operation need?''*

Parts of the solution to improve the experience for People with Disability are already in place, for the most vulnerable travellers:

> *'There is an app for people with motorised scooter or wheelchair. The app would alert the officer where a person with wheelchair is arriving the station, allowing the staff to know and provide boarding assistance.'*

Human presence or assistance will likely remain a necessity, the question is how to utilise it most effectively.

> *'Extension to the Western line which reaches Paramatta, there will be a total of four new lines. We don't need ramp as it is total accessible. Another thing that came out of our research is that we do require human assistance of some form.'*

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Mark Patterson
Matthew Jones
Michael Kane
Paula Gleeson
Rob Van Der Zalm
Sherri Fields
Stephanie Manning
Stuart Donohue
Sue Wiblin
Virginie Vernin

and iMOVE

Emilie Alexandre
Renae Leeson

Thank you

AFDO
Physical Disability Council of NSW

Blind Citizens Australia
Deaf Society
Deafness Forum
Guide Dogs NSW ACT
NSW Council for Intellectual Disability
Paraquad
People with Disability Australia
Physical Disability NSW
Spinal Cord Injuries Australia
Stroke Recovery Association
Vision Australia

Airport Link – Sydney's Airport Train
Transdev Australasia
Sydney Metro
Sydney Trains
Transdev, operator of Sydney Ferries

And all People with Disability who participated in our workshops