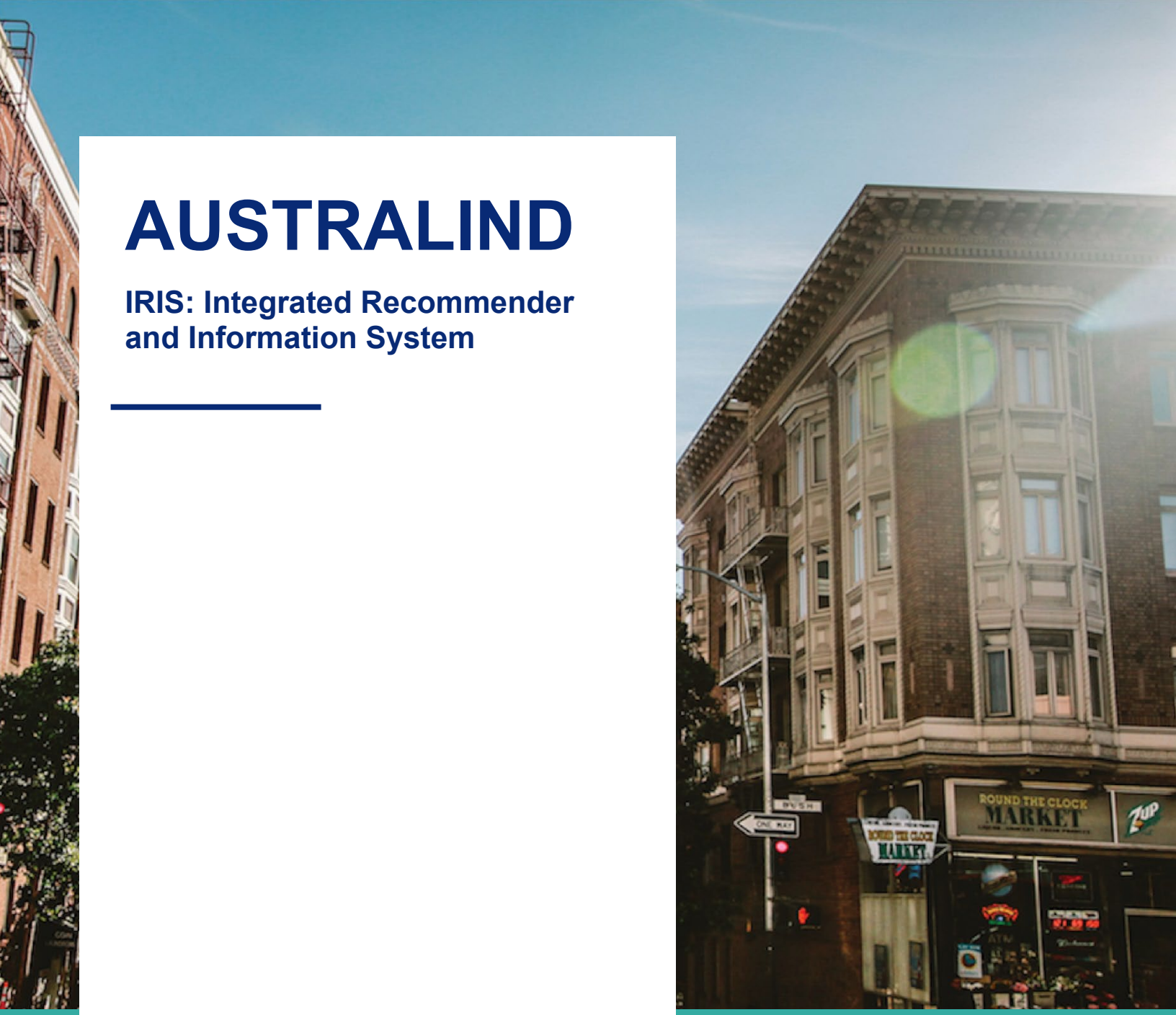


# AUSTRALIND

## IRIS: Integrated Recommender and Information System

RISSB
RAIL INDUSTRY SAFETY AND STANDARDS BOARD

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**Authored by:** Alaman Altaf, Bayley Mohr, Clarence Chung, David Burns, Demetrius Liang, James Butt, Lien Pham, and Trinity Burke

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# 1 Executive Summary

This report outlines a strategic approach for the IRIS project, designed to transform Australia's public transport system. Currently, the rail sector in Australia faces significant challenges due to reliance on outdated manual processes and fragmented legacy systems. These issues result in operational inefficiencies, limited real-time information, and a suboptimal passenger experience.

IRIS aims to address these challenges by integrating advanced technologies such as Artificial Intelligence, Internet of Things, digital twins, and machine learning into a unified platform. This system will streamline information from disparate sources, enhance operational efficiency, and deliver personalised travel experiences. Key features include real-time updates, predictive analytics, and digital avatars that provide friendly, tailored guidance to users.

**"Revolutionise the public transport experience by integrating real-time network status and configurations into a unified, user-friendly platform"**

The proposed strategy includes launching pilot programs to refine the system, engaging stakeholders for comprehensive integration, and implementing a phased rollout across major urban centres and beyond. By leveraging IRIS, the public transport network can improve service reliability, user satisfaction, and support sustainability goals, ultimately modernising the system to meet dynamic market demands and enhancing overall public transport effectiveness.

# 2 Introduction

The current landscape of public transport presents a fragmented and often frustrating experience for passengers caused by delays in information dissemination, the complexity of managing multiple apps, and a heavy reliance on a passenger's capacity for navigating and understanding the transport network. Despite the significant efforts rail operators invest in operational technologies, station facilities and strategic and disruption planning, this progress often fails to translate into a seamless end-user experience. Contributing factors include language barriers, diverse and multiple user interfaces, and insufficient user feedback, which collectively impede the efficiency of public transport systems.

In response to these challenges, the Integrated Recommender and Information System (IRIS) system is proposed to revolutionise the public transport experience by integrating real-time network status and configurations into a unified, user-friendly platform. IRIS aims to transcend traditional route-based guidance, transforming the journey into an immersive experience tailored to each passenger's individual needs, interests, and physical capabilities. By incorporating comprehensive network information such as public events, notable locations, environment conditions, dining options, and cultural points of interest, IRIS will not only guide users through their transport routes but also transform their overall urban experience.

A key innovation of IRIS is the use of digital avatars, designed to provide a personable and engaging interface. These avatars will leverage advanced AI learning algorithms to understand and adapt to each passenger's unique interaction with the network, optimising their travel experience.

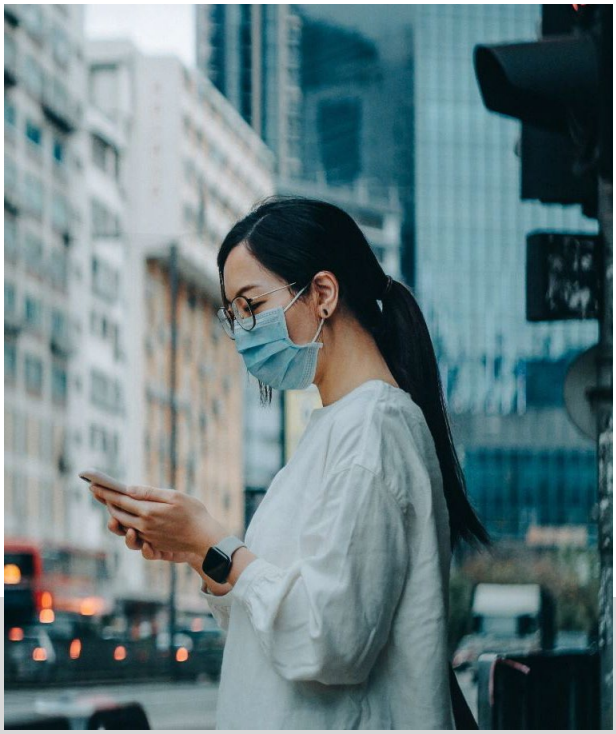
Furthermore, IRIS integrates cutting-edge technologies, including IoT for asset health monitoring, digital twins for predictive maintenance, blockchain for secure and seamless payments, and AI and machine learning for data analysis and user personalisation. By synergising these emerging technologies, IRIS promises to deliver a cohesive and highly responsive public transport system that meets the evolving demands of modern urban travel.

This report presents a proposed strategy for the IRIS project, designed to address the evolving needs of Australia's public transport system. It offers a detailed analysis of the current state of public transport in Australia, including an examination of existing challenges that hinder the widespread adoption and effectiveness of public transport services. Additionally, the report outlines the innovative solution provided by IRIS and provides a strategic plan for scaling and implementing this solution across the nation.

# 3 A Current Affair – Australian Public Transport

The commuter landscape for public transport in Australia has undergone notable shifts, influenced by several emerging trends. The COVID-19 pandemic initially caused a sharp decline in ridership due to lockdowns and social distancing, and while recovery is ongoing, commuter numbers are still 20% lower than pre-pandemic levels and 158 billion passenger kilometres were travelled by car on capital city roads in 2022-23. Many Australians have adapted to remote and hybrid work models, leading to a decrease in daily commutes and altering traditional peak-hour patterns.

Technological advancements have significantly impacted public transport use. Digital tools and apps for real-time updates, trip planning, and smart ticketing solutions—such as Sydney's Opal and Melbourne's Myki—are increasingly popular among commuters. These innovations streamline travel and enhance convenience.



Sustainability is also a growing concern. There is a noticeable shift towards environmentally friendly transport options, with public transport being favoured for its lower carbon footprint compared to private vehicles. Investments in electric and hybrid buses and energy-efficient infrastructure reflect this commitment to sustainability.

In terms of accessibility, improvements are being made to ensure public transport is inclusive for all users, including those with disabilities. Enhanced infrastructure and services aim to provide a more user-friendly experience.

Infrastructure development continues with major projects focusing on expanding rail lines, upgrading stations, and improving service reliability. These initiatives are designed to address capacity issues and enhance connectivity across urban and regional areas. At least $16 billion in funding for the rail investment component of the Infrastructure Investment Program was announced by the federal government in the 2024-25 budget.

Overall, the Australian public transport sector is adapting to evolving commuter needs, integrating technology, and focusing on sustainability, while striving to recover from the pandemic's impact and improve overall service quality. However, Australian public transport sector continues to lag other world class transport operators due to legacy systems, clunky manual systems and technological debt that has had impacted the end user, the passenger. This impact has been analysed to determine the barriers of public transport use.

## 3.1 What Makes Public Transport Not So Friendly?

### 3.1.1 Accessibility

Just because something is accessible for someone with a mobility aid or issue, this doesn't mean it is totally equitable. These people might need physical assistance from others and might not be able to complete their journey with the same sense of privacy, security, and safety as someone without these issues.

A variety of free and paid smartphone applications are now available, offering comprehensive timetables for various modes of transportation, including buses, trains, and other transit options. These apps provide users with quick and easy access to real-time schedule information, allowing them to efficiently search for the next available bus or train. Many of these applications also offer some level of multi-modal trip planning, enabling users to seamlessly combine different forms of transportation for optimal journey routes. However, they often lack the use of universal design principles required in the development of the systems to make sure they are useable for the people who could benefit from them the most. This digital divide highlights the need for alternative, accessible methods of distributing transit information to ensure equitable access for all members of the community.

### 3.1.2 Disruptions, Emergency Response and Passenger Behaviour

During service disruptions, information dissemination typically relies on official websites, social media platforms, and Passenger Information Displays (PIDs). However, this approach often falls short of meeting passengers' needs effectively. The information provided is frequently limited in scope and detail, failing to offer comprehensive guidance on alternative routes or expected resolution times. Moreover, delays in updating this information are common due to the manual processes involved in gathering, verifying, and distributing data across multiple channels. This lag can leave passengers in a state of uncertainty and frustration.

In such situations, passengers are often forced to scramble for alternative services without adequate guidance. The problem is exacerbated in densely populated areas or during peak hours when mobile networks may become congested due to high usage. This network overload can prevent some passengers from accessing online timetables or real-time updates, further complicating their ability to make informed decisions about their travel plans.

Overcrowding and accessibility issues are common during emergencies, complicating evacuation and safety efforts. Additionally, safety risks arise from the immediate threat and from panic and confusion among passengers. Ineffective emergency coordination can also impact how quickly and effectively help reaches those in need.

Passengers may experience significant psychological stress due to the potential danger, which can impair their ability to make rational decisions. Infrastructure damage can complicate response efforts, and efficient evacuation can be difficult due to the layout of the transport system, the number of passengers, and the specific nature of the emergency.

### 3.1.3 Public Transport's Role in Tourism

Many cities have been digitalising public transportation for commuters and tourists with innovative technologies. Digital ticketing systems such as the Opal system in Sydney is offering a simplified experience to commuters and tourists.

Additionally, real-time information systems provide commuters and tourists with up-to-the-minute updates on route schedules and traffic conditions, and numerous travel apps are available to provide public transportation information and route planning services, ultimately helping passengers plan their trips with ease and convenience. These improvements and the positive impacts they have on the commuter experience show the benefit that comes with integrating digital technologies and public transport use.

### 3.1.4 Environmental Considerations

The environmental benefits of public transport use are well documented, and moving commuters away from cars and onto public transport is a goal for any green city.

On the other hand, AI, blockchain and similar digital technologies have a range of negative environmental impacts such as reliance on non-renewable energy sources, substantial water use for equipment cooling, precious metal use in equipment and manufacturing, and use of workers from countries with poor labour practices and a reliance on brown energy sources. All of these can occur in both the model/asset development stages and during information processing/operation stages.

As an example of the scale of energy use by technology, data centres alone currently account for approximately 1.5% of the total global energy use, and the training of GPT3 (an earlier version of ChatGPT released in 2022) reportedly required an equivalent power consumption to the annual usage of 130 homes in the USA.

### 3.1.5 Regulatory Compliance

Australia currently does not have specific regulations for IoT, blockchain, Digital Twin or overall use of AI in any application, let alone when being integrated with public transport.

These technologies are currently governed by the combination of existing consumer and product level guidelines, laws, and standards, including but not limited to:

- Privacy Act 1998
- Telecommunication Act 1997
- Australian Consumer Law (ACL)
- Cybersecurity Frameworks

This lack of regulation is in the process of being addressed by the industry and government, for example Standards Australia in 2023 adopted ISO/IEC 42001, *Information technology - Artificial Intelligence - Management System* and on 5th Sept 2024, the Department of Industry, Science and Resources issued an AI Safety Standard, however, compliance to it is currently voluntary.

# 4 IRIS - What is a Fully Integrated PT AI Assistant?

IRIS will combine a technology-heavy backend with a soothing, human factors-informed user interface. The specific interface with the passenger can grow with available technology and be integrated as augmented reality and agentic AI systems advance.

Real-time information will be fed to the passenger with information such as journey suggestions, ticketing information, tourism suggestions, safety warnings and route changes due to interruptions seamlessly integrated into an AI-produced avatar tailored to the passenger's needs and communication requirements. Language and accessibility requirements will be incorporated without the passenger having to inform the system and machine learning will enable the growth of the system the more a passenger uses and engages with the system.

**"IRIS - Providing a seamless passenger journey start to end"**

Behind the scenes, the system will feed back into the network information from users, so machine learning and predictive analytics technologies optimise routes and schedules, predicting ridership and traffic. Natural language processing will enable to avatar to interface with the user naturally and provide contextual, personalised assistance. AI-powered computer vision systems will feed data back to report public crowding, accessibility issues, and information about the traveller's environment.

Fare payments will be automatic based on the passenger's usage and this can be integrated with a larger, city-wide system of payments for other public and private services such as cafes, museums, entertainment venues and libraries. From start to finish, the passenger will benefit from a seamless user experience, the operator from data feedback and the city becomes a less crowded, more integrated environment that works for all citizens.

## 4.1 A Future That Benefits All

### 4.1.1 Accessibility for All

IRIS will take the guesswork out of planning a journey for transport users with mobility or other impairments by providing accurate real-time information about accessible services. IRIS would provide the user with direct information about what stops / stations/precincts are fully accessible or, advise when the next accessible service (such as a low-floor tram) is due to arrive at a stop most convenient for the user.

IRIS will provide a more efficient and usable service than current transport apps by reducing the number of app actions required for the user to get the information they need. A personalised AI assistant would also reduce effort and fatigue by removing the complexity out of journey planning decision-making. This could be achieved using personalised information based on the user's direct inputs (preferences) and any data it has gathered on past journeys and decisions.

An AI assistant would also help reduce the need for external assistance from others for users with mobility or other impairments, leading to increased safety, privacy, and security. This is in line with universal design principles and would contribute to greater universal design for existing transport assets.

### 4.1.2 Disruption, Emergency Response and Passenger Behaviour

IRIS could revolutionise public transport during emergencies by providing real-time scenario modelling, adaptive responses, and enhanced communication. It could offer personalised alerts and guidance, optimise evacuations, and automate assistance through chatbots. The IRIS avatar will provide a comforting presence during the emergency to reduce stress and trauma.

IRIS could also improve resource allocation and learn from past incidents to refine emergency responses. This integration would lead to more efficient, responsive, and personalised management of public transport emergencies, enhancing passenger safety and experience.

### 4.1.3 Operational Efficiency

#### Minimising reliance on technological proficiency

IRIS enhances access to public transportation information and trip planning across various providers by bridging the gap between humans and technology. The system offers voice-based timetable information and customised journey planning, adapting to individual travel patterns and preferences by analysing factors that influence daily commute choices.

As users near their destination, IRIS can proactively suggest and facilitate the booking of last-mile transportation options like taxis or ride-sharing services, ensuring a smooth door-to-door travel experience. The system can also deliver timely reminders about upcoming train arrivals through various means, such as LED displays or audio announcements at key locations.

Furthermore, IRIS-powered smart digital signage can present real-time updates, suggest alternative routes, and interact with users through natural language voice queries. This comprehensive approach makes public transport information more accessible and user-friendly for all passengers, including those with disabilities, regardless of their technological proficiency.

#### Reduce Impacts of Service Disruption

By rapidly collecting and analysing real-time data, IRIS can swiftly generate accurate and relevant messages for users and on Passenger Information Display systems. This capability ensures that travellers receive timely updates about service changes, delays, and alternative routes. Passengers accessing timetable information through IRIS can obtain the most current schedules and personalised journey plans that incorporate replacement services. This dynamic approach to information delivery allows travellers to make informed decisions quickly, reducing confusion and frustration.

The speed and efficiency of IRIS in disseminating crucial information significantly mitigate the impact of disruptions on both passengers and railway operators. Passengers can adapt their travel plans promptly, while operators can manage crowd flow more effectively and allocate resources efficiently. Ultimately, this rapid

response system enhances the overall resilience and reliability of the public transportation network, benefiting all stakeholders involved.

### 4.1.4 Tourism Impacts

Personalised recommendation and trip planning in tourism aim to enhance the travel experience by tailoring suggestions to individual preferences, interests, and past behaviours. Tourist satisfaction will be greatly improved when travel plans can be adjusted seamlessly based on real-time data, and friction points can be removed when navigating between different transport modes to tourist attractions with IRIS assistance in trip planning.

Moreover, enhanced customer service offers immediate assistance and support, addressing inquiries and resolving issues in real-time. Features such as instant language translation can bridge the communication gaps and enable tourists to engage more deeply with local cultures.

### 4.1.5 Environmental Impacts

The implementation of IRIS will need to reduce environmental impacts by employing methods such as sourcing electricity from green sources, using cloud servers that monitor their energy and water sources and usage, and placing a focus on the working conditions of staff and human resources at all stages of development and operation.

Tangential benefits would be achieved by considering the efficiency of the entire ecosystem. During development, a model may take up more resources, however, if the outcome is a more efficient model during operation, then this balance of resource use can be beneficial overall. The environmental impact of the manufacture of the hardware and its disposal at end of life will also be assessed.

IRIS would set out to be an environmentally friendly service in addition to this, moving passengers from less carbon-friendly cars and buses to environmentally friendly public transport services like rail. It will also reduce or streamline journey times, correspondingly reducing workload and crush loads on the services for operators. AI Prediction of passenger flow can also aid with improving efficiency on other parts of the network for example an escalator could be paused if passenger throughput is expected to decrease.

The overall goal is a whole-of-life environmentally efficient system that increases passenger use of public transport networks, makes the operation of that system more environmentally friendly, and ensures the AI system is developed and run in a green manner.

### 4.1.6 Regulatory Compliance

The regulatory framework would need to integrate discipline-specific standards and legislations with transport sector regulations – especially where they interface with safety.

Overall, the regulatory framework would have to be hierarchical. Each level of the system will be required to comply with domain-specific regulations, but they would also need to ensure that the integration of those individual systems itself is regulated. An ecosystem approach to managing and operating this would be adopted.

Given the amount of personal information and organisational information IRIS will have access to, there would need to be robust frameworks in place to ensure information is accessed, stored and disseminated appropriately.

A clear set of legislative boundaries would be implemented to prevent any misuse or abuse of the technologies with proper oversight from a federal body. RISSB along with various governments could take the lead in developing the standards specific to the application to Public Transport.

Australia currently does not comply with or have regulations similar to the General Data Protection Regulation (GDPR), given IRIS will cater to tourists as well, it would need to either comply with GDPR or an equivalent regulation. As the rail industry and these technologies evolve, the regulatory frameworks governing them would need to as well. Compliance with safety, environmental, and operational regulations would be essential for maintaining public trust and operational integrity. Some of the technologies themselves (such as blockchain) could offer solutions for ensuring regulatory compliance by providing an immutable and transparent record of all transactions and operations. These technologies can facilitate real-time reporting and auditing, ensuring that public transport operators meet regulatory requirements efficiently and effectively. A proactive approach would not only enhance compliance but also foster a culture of accountability and transparency within the rail industry.

# 5 Delivery Strategy

Scaling IRIS for public transport across Australia involves several key steps:

- **Standardisation**: Develop standardised protocols and data formats for systems to ensure consistency across different regions and transport networks.
- **Infrastructure Integration**: Integrate digital solutions with existing public transport infrastructure, including buses, trains, and trams, as well as communication networks.
- **Collaborative Framework**: Establish collaboration between federal, state, and local governments, along with transport authorities, to coordinate implementation and emergency response strategies.
- **Scalable Technology**: Use cloud-based solutions to ensure scalability and flexibility, allowing the system to handle varying levels of demand and geographic coverage.
- **Data Sharing**: Implement secure data-sharing practices to enable AI systems to access and analyse real-time information from different regions and transport services.
- **Training and Support**: Provide training for transport staff and emergency responders on using AI tools effectively and ensure continuous support for system maintenance and updates.
- **Pilot Programs**: A pilot program will be completed in an area with multi-modal interfaces such as the Melbourne CBD to test and refine the AI systems before broader deployment.
- **Public Engagement**: Educate the public about the new AI-driven emergency management tools to ensure they understand how to use them and respond appropriately.

To effectively roll out AI across Australian public transport, a pilot program would be undertaken in an area such as Melbourne's CBD. The pilot will test IRIS's capabilities in a controlled environment, focusing on emergency management and passenger information. Performance will be evaluated through user feedback and performance assessments to identify both opportunities and challenges. Following the pilot, the collected data can be analysed to refine AI algorithms and operational procedures.

Implementation would be gradually expanded throughout Victoria, applying lessons learned from the pilot and ensuring smooth integration with regional transport systems. The next stage would capitalise on the high visibility during the Brisbane Olympics to showcase the AI system, adapting it to manage large crowds and varied transport needs. Tourists would further benefit as it is implemented across Sydney's extensive public transport network, coordinating closely with local authorities to address specific challenges. Finally, scale the deployment to other major cities and regions across Australia, providing ongoing support and updates based on insights from earlier phases.

## 5.1 Implementation Challenges

The adoption of advanced technologies and Artificial Intelligence within the public sector has recently been gaining momentum to help improve the management of internal activities and deployment of public services. However, such implementations can encounter a range of challenges, which can be summarised into three main contextual categories: technological, organisational and environmental.

### 5.1.1 Technological Challenges

When implementing digital technologies, integration with current transport infrastructure and legacy systems can be complex and may require significant technical adjustments. On top of this, as AI has the ability to interact, learn, and evolve through continuous relationships with both the environment and humans, this requires not only technical maintenance but also continuous human engagement to ensure it is functioning as desired. Significant data needs to be not only be available, but rail transport operators (RTO) will also need to be able to control, feed, and manage this data which is essential for the proper functioning and training of AI algorithms.

Given the project objective for IRIS is to ensure a seamless journey experience, this problem is further exacerbated with the requirement to work across different modes of transport and with various regional transport authorities to provide cohesive and unified services. Scalability will be impeded unless the rollout is able to accommodate the varying levels of demand and infrastructure across the different states.

### 5.1.2 Organisational Challenges

With any new operational technology to be launched into use, considerations around the systems it impacts requires analysis of not only current technologies but also the human factors. Training staff and users to effectively use and trust new technologies will be required. Maintaining a long-term view towards balancing the initial investment in new technology and managing ongoing operational and maintenance costs will be vital.

### 5.1.3 Environmental Challenges

The support from suppliers for the implementation of technological advancements is essential for public RTOs, where expertise for such novel technologies is typically immature. Thus, access to external suppliers to leverage their knowledge skills will be crucial. RTOs need to be well versed in choosing appropriate vendors, which can be difficult with the lack of laws and policy frameworks regulating future technological implementation.

This can have both a detrimental or beneficial effect for early adopters, as it provides freedom for selecting suppliers however unregulated implementation can cause public distrust especially with the data needs for sensitive passenger info. Clearly communicating the benefits and functionalities of systems to passengers is important to ensure they understand and utilise the new systems effectively, along with robust cybersecurity measures to prevent breaches and unauthorised access to data and systems.
Addressing these challenges involves careful planning, stakeholder collaboration, and iterative testing and refinement.

# 6 Conclusion

Navigating a public transport system in a large city often presents a daunting challenge, whether for newcomers or seasoned users. The constant flux of delays, route changes, new events, and public emergencies contributes to a complex and ever-changing information environment. While various digital systems—such as IoT sensors, live public databases, and system-level digital twins—already track these dynamic elements, they operate in isolation, creating a fragmented and inaccessible experience for users.

IRIS will revolutionise this landscape by integrating and streamlining these disparate information sources into a cohesive platform. Using advanced machine learning and AI, IRIS will sift through the complex, multidimensional data to deliver a personalised and intuitive travel experience. This system's emphasis on friendliness and companionship aims to make public transport not only more pleasant but also more supportive and engaging for anyone and everyone.

Beyond enhancing the immediate travel experience, the implementation of IRIS promises broader benefits, including improved overall wellbeing for users and the advancement of societal sustainability goals. By creating a more seamless and user-centred public transport experience, IRIS contributes to a more connected, efficient, and sustainable urban environment. As we look to the future, IRIS represents a significant step toward transforming public transport into a more responsive, supportive, and integrated component of daily life.

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