Australasian Railway Association

Submission

The Australian Communications and Media Authority's - Expiring spectrum licences: stage 2

Supplementary: SA / WA / Qld

20, September, 2024

ABN: 64 217 302 489

Australasian Railway Association

The ARA

The Australasian Railway Association (ARA) is the peak body for the rail sector in Australia and New Zealand, and advocates for more than 220 member organisations across the industry.

Our membership covers every aspect of the rail industry, including the:

- passenger and freight operators that keep essential rail services moving;
- track owners, managers, and contractors that deliver a safe and efficient rail infrastructure network; and
- suppliers, manufacturers, and consultants that drive innovation, productivity, and efficiency in the rail industry.

Our members are driven to support vibrant, sustainable and connected communities through greater use of rail across Australia and New Zealand. We bring together industry and government to help achieve this ambition.

Our advocacy is informed by an extensive research program to ensure we offer solutions that are grounded in evidence and focused on delivering tangible value in our daily lives.

The rail industry has a crucial role to play in the region's sustainable development and growth, and offers meaningful and rewarding careers for tens of thousands of people in the regions.

Our significant program of work is focused on supporting a strong advocacy agenda, and creating opportunities for the rail industry to network, collaborate and share information, and maximise the benefits we have to offer the wider community.

The ARA thanks the Australian Communications and Media Authority for the opportunity to make this submission, which has been developed in consultation with ARA member organisations.

Any questions regarding this submission should be directed to [redacted], General Manager Passenger Rail and Safety via [redacted]

Australia's Rail Industry

Rail is a significant industry in Australia, creating economic activity through its operations and capital investments. It is an industry with activities across every major metropolitan and regional area and is supported by the full spectrum of skills in the Australian workforce.

In 2019, the rail industry contributed around $30 billion to the Australian economy and employed more than 165,000 workers (directly and indirectly in full-time equivalent terms, FTE). The industry is made up of around 900 businesses that are located in approximately 20 major hubs.

Contents

Introduction

ARA welcomes the opportunity to provide additional information to previous submissions - Expiring spectrum licences: stage 2.

This submission provides information relating to Queensland, South Australia, and Western Australia.

It is intended to supplement, and be read in conjunction with previous submissions.

Why the railway takes a coordinated approach to ACMA consultations; ref NTC's National Rail Action Plan.

1.0 Introduction

This appendix contextualises the National Rail Action Plan (NRAP)[1] in the view of the need to retain radio spectrum harmonisation in the 1800 MHz band for the rail industry across Australia.

The National Transport Commission (NTC) prepared NRAP for the Transport and Infrastructure Council (TIC). The NRAP aims to implement changes to improve delivery of rail infrastructure and improve the safety and productivity of rail operations. Two focuses of the NRAP are:

- To improve the efficiency and safety of Australia's rail system by continuing to align or harmonise operating rules, infrastructure and operational standards and systems across the nation's rail network.
- To create opportunities for manufacturers of rail equipment to supply rolling stock [trains] and components.

A Memorandum of Cooperation (MoC)[2] has been signed by all Australian state and territory governments, the Australian Minister for Infrastructure, Transport, Regional Development and Local Government, Hon. Catherine King MP, the Australian Railway Association and many rail operators and industry participants. The MoC provides an

[1] https://www.ntc.gov.au/sites/default/files/assets/files/National-Rail-Action-Plan.pdf

[2] https://www.ntc.gov.au/sites/default/files/assets/files/Memorandum%20of%20Cooperation%20for%20Interoperability_1.pdf

undertaking by participants to consider rail system interoperability ahead of future major rail investments. It includes consideration of technical systems.

The following content extracts sections of the NRAP and provides context on the relationship to the need to retain the 1800 MHz radio spectrum band across Australian railways.

This paper does not include any content or positions relating private railways such as those used in mining operations.

2.0 Key principles:

The following key principals underpin the positions made in this appendix:

- The retention of the 1800 MHz radio spectrum band across Australian railways enables the future transition of all Australian railways to common radio technology.
- The future transition of all Australian railways to common radio technology enables a corresponding transition to the following:
- Interoperable on-train radio equipment, allowing a train crossing multiple jurisdictions to communicate multiple control centres and other trains with only a single set radio equipment equipped.
- Common signalling and controls systems which use the radio technology.
- Common operational procedures and ways of working.
- The complete transition of all Australian railways to common radio technology is dependent on individual jurisdictions making investment decisions relevant to their local contexts.
- The use of 10 MHz of radio spectrum in the 1900 MHz band does not provide sufficient bandwidth for rail safety and control communications. It needs to be complemented by the existing bandwidth held by rail operators in the 1800 MHz spectrum. This need stems from Europe and the UK who have kept allocated spectrum in the 900 MHz band as well as allocating 10 MHz in the 1900 MHz band. Additionally, we can look to modern commercial networks evolving through each 3GPP generation using staged transitions that require additional spectrum bandwidth to support. This need will be ongoing as technology continues to evolve, railways will need to evolve their mobile networks to reduce support costs and risks relating to supportability and security of old technology.

3.0 The problem statements:

3.1 High costs from vendors

> "The Senate's Rural and Regional Affairs and Transport References Committee 2017 Inquiry into Australia's rail industry noted that rather than Australia being represented by one central, national market, Australia has historically been made up of a number of smaller, fragmented rail markets. This continues to act as a deterrent to investment in larger scale manufacture and innovation. Scale also acts as a barrier to expansion. The problems are compounded by the inefficiencies associated with manufacturing railway products to different standards and specifications."

The Australian rail industry market for rail radio technology is small and fragmented. In the 2000's there were 20 different rail radio systems in use across Australia with most states using different radio systems for their suburban and country rail networks[3].

The Global System for Mobile Communications – Railway (GSM-R) is used by New South Wales (NSW) and Victoria (VIC), with Queensland (QLD) currently delivering a GSM-R network. These networks operate in the 1800 MHz band.

The European rail network, as global leaders, operate on a GSM-R network in the 900 MHz band. Manufacturers build train radios for GSM-R specifically to operate in the 900 MHz band as Europe is their largest customer base. This equipment is incompatible with the networks used in NSW, QLD and VIC. As such, manufacturers had to procure special builds of their train radios to operate in the 1800 MHz band for only three small private radio networks. This came at a high cost.

The National Train Communications Network (NTCS) introduced custom radio equipment for trains travelling across multiple rail radio networks in December 2014.This custom radio equipment is essentially multiple radios interfacing to a single driver display unit. This solved human factors and space issues relating to trains travelling across multiple rail networks, and multiple rail radio networks, to require fitment of multiple radios in the driver's cabin[3]. However. the use of this custom radio equipment comes at a high cost as all rail operators are locked into a single local supplier.

[3] https://wongm.com/2022/08/australia-incompatible-train-radio-systems/

3.2 High costs from infrastructure standards

"There are eight Rail Infrastructure Managers in Australia and more than 50 above-rail operators, including freight and passenger operations. When new infrastructure is built, each RIM individually determines the technical standards it requires to enable it to meet its safety obligations under the national law.
This multiplicity of different standards, and different infrastructure outcomes, across Australia (both on networks within and outside each State/Territory) is causing inefficiencies for government and industry, including higher procurement, delivery and maintenance costs. The problem has become critical during the current period of unprecedented investment by governments in new rail projects."

The use of multiple radio technologies across Australian railways constrains any opportunity to align or combine engineering standards for radio systems across railways.

Governments and industry needing to procure, deliver and maintain these radio systems must incorporate requirements from all relevant radio standards, which may be many depending on the project. This causes inefficiencies, increasing costs for all activities.

3.3 High costs from multiple technologies

"There are at least 11 different signalling and train control systems in use across Australia, with each state having its own distinct safe-working rules – meaning there are around 17 distinct safe-working systems across Australia. This extensive array of systems imposes additional costs in management, maintenance and competency training for both network managers and operators."

As noted in Section 4.1, multiple radio systems are in use across Australian railways. These systems support the 11 different signalling and train control systems noted in the NRAP as well as providing critical voice communications.

4.0 The benefits:

"The Bureau of Transport and Regional Economics (BITRE) Optimising harmonisation in the Australian railway industry (2006) identifies that in addition to different gauges, other technical, operational, regulatory and administrative inconsistencies have also impeded the flow of rail traffic. BITRE notes that harmonisation may deliver benefits such as lower input costs, improvements in operational efficiency, higher inherent safety and lower training costs. It can also widen rail's freight market. Conversely, it notes there are commercial pressures and historical legacies that mitigate against greater standardisation."

The harmonisation of spectrum holdings supporting rail radio communications systems will improve operational efficiency by allowing each rail jurisdiction to migrate to a common communications technology, the Future Railway Mobile Communication System (FRMCS).

The migration of every rail jurisdiction to FRMCS will take time, with each organisation constrained by their investment lifecycle processes including the time and cost of developing business cases and competition with other government initiatives.

This long-term strategy to use a common technology supports the benefits noted by BITRE by facilitating the alignment of rail standards and safe working rules and procedures for rail safety communications across Australia. This alignment then facilitates the following benefits.

4.1 Lower costs from vendors

The Australian rail industry can provide radio system vendors an aligned and clear product and service need for the long-term across all Australian railways, encouraging their investment and efficient operations. These vendors can then pass on some of these savings to the rail operators who in turn pass some of the savings to the government, with improved visibility for longer term contractual arrangements that benefit all parties.

4.2 Lower costs for training and certifications

Training and certification standardisation across Australia for working on FRMCS networks. This will reduce costs by reducing the amount of bespoke training and certifications developed by each rail operator. The rail operators can then pass on some of these savings to the government.

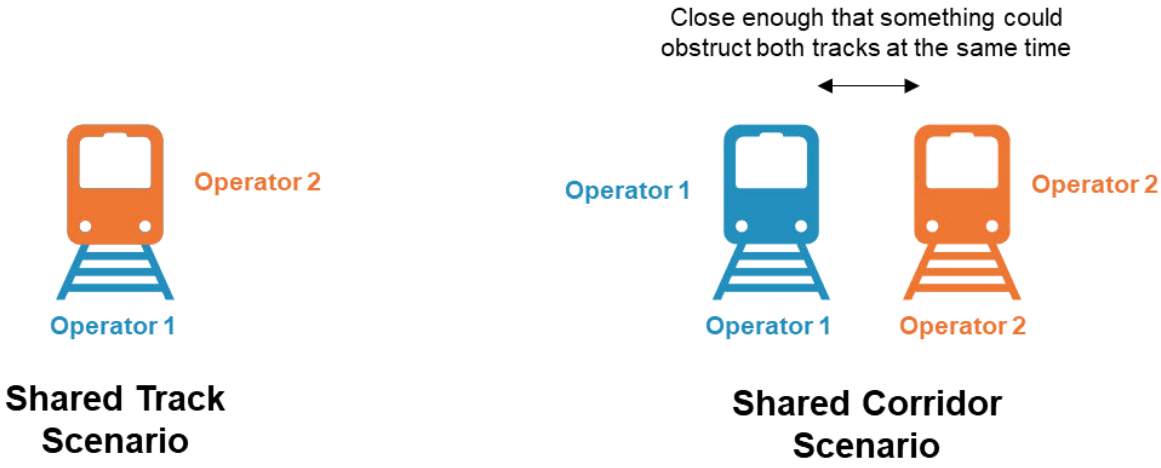
4.3 Mobilising workers to bridge the skills gap

FRMCS training and certification can be standardised across Australia will encourage mobilisation between jurisdictions. Unlocking mobilisation between jurisdictions will reduce the overall need for this expertise in Australia where these skills are in short supply, bridging some of the skills gap.

4.4 Improved safety, operational efficiency and lower cost from interoperability improvements

Rail radio interoperability is an issue where trains:

- Travel on infrastructure managed by a different rail operator (like signalling system interoperability issues) – Shared Track Scenario
- Travel in parallel to infrastructure managed by a different rail operator (unique to rail safety communications) – Shared Corridor Scenario



The diagram above shows examples with just two operators, but in the Australian rail network there are locations where there are additional operators in the vicinity or on the same tracks, and trains that travel across the networks of multiple other operators.

Currently, there is limited interoperability of radio systems at these locations. Interstate trains are equipped with a radio unit that includes multiple radio modules to enable the driver to communicate to multiple rail operators. These modules currently include analogue, GSM-R, and 4G. This piece of equipment has partially solved the human-factors issues and space constraints related to a driver having to use multiple radio units, that is one for each rail operator's jurisdiction the train travels through. There remain some areas of Australia where trains need to be fitted with more than one piece of rail equipment but more importantly, the consolidation of the on-train equipment does not completely solve the problem of interoperability.

True interoperability for rail safety communication systems would support the following example scenario.

- Safety Scenario: A train derails and obstructs rail tracks.
- A Railway Emergency Call (REC) is broadcast to all trains in the area heading towards the obstruction no matter which rail operators are running the train or operating the tracks.
- All train drivers in the area follow common operational procedures to apply emergency breaks immediately upon hearing the REC.
- Operators in each rail operators control centre can talk with all drivers to resume operations or invoke additional emergency procedures as required

True interoperability does not currently exist in the Australian railway network. The best interoperability we have achieves the first two bullets in the safety scenario above, but not the last one. This interoperability exists where a train is equipped with radio equipment that can connect to the radio network of the operator who operates the track the train is travelling on. This level of interoperability is not available across all Australian railways.

4.5 Improved operational efficiency by supporting interoperable rail signalling and controls systems

The transition to interoperable rail signalling and controls systems will improve operational efficiency. These systems use radio communications for their core functionality. To ensure rail signalling and control systems are interoperable, the underlying radio communications also must be interoperable. Interoperable radio communications systems throughout Australia's railways, therefore, also supports improved operational efficiency outcomes.

Additionally, true interoperability of rail radio communications systems as described in Section 5.4 above, contributes to improved operational efficiency by reducing time to coordinate recovery or transfer between each rail jurisdiction through voice communications.

5.0 Conclusions

The 1800 MHz radio spectrum band across Australian metropolitan railways must be retained to support interoperability across all Australian railway radio networks. This directly supports the NRAP and associated benefits including lower costs, improved safety, and improved operational efficiency.

Queensland Rail

Introduction

Queensland Rail is the operator of passenger and freight rail services in both South East Qld (SEQ) and regional Qld. The SEQ passenger rail network is bounded by varsity Lakes to the South, Rosewood to the West, Gympie to the North, and Cleveland to the East, with branch lines to Ferny Grove, Doomben, Shorncliffe, Redcliffe and the Airport. The regional network stretches out to the extremities of the state of Qld including Brisbane to Cairns with western lines to Forsayth, Mt Isa, Longreach and Charleville. The Queensland Rail network extends more than 6,600 kilometres (km) across the state.

Qld Rail has been connecting communities since 1865 and supporting local jobs, industries, and economies. Queensland Rail is committed to delivering world-class rail services for customers, that are safe and reliable.

Queensland Rail operates 8,392 SEQ passenger services and eight long-distance travel and tourism services per week. In FY24, this amounted to more than 47 million customer trips (SEQ and Regional) across the year. Queensland Rail also manages rail assets that support freight services across its network. In FY24, 14 billion gross tonne kilometres were hauled across the Queensland Rail freight network.

SEQ's population is currently around 3.8 million, but projected to increase by almost 2.2 million to around 6 million by 2046. South East Queensland is growing - Ministerial Media Statements

Queensland Rail is also getting set to be on the world-stage for the Brisbane 2032 Olympic and Paralympic Games. In the lead up to 2032, Queensland Rail plans to integrate more than $20 billion of new assets into the rail network, including game-changing projects like Cross River Rail and the European Train Control System (ETCS), as well as more trains and new and upgraded stations.

Access to 1800MHz spectrum is essential to implement ETCS L2 and provide rail safety and control communications for the rail network in order to meet the demands on the public transport system.

This paper provides additional information specific to Queensland Rail that supplements the submission by the ARA in response to ACMA's Stage 2 ESL consultation.

Public interest criterion 1: facilitates efficiency

Current Use

Queensland Rail holds two licences in the 1800 MHz band detailed below:

License Number	Spectrum	Bandwidth	Special Conditions
9263460	1770-1775, 1865-1870	5MHz	Nil
9367783	1775-1785, 1870-1880	10MHz	Rail Safety and Control communications

In 2010, Queensland Rail commenced development of a business case to implement ETCS L2 in the SEQ passenger rail network. After numerous reviews by successive state and federal governments, the business case was approved in 2016 to implement ETCS L2 in the Inner City, including the Cross River Rail tunnel, with a pilot line on the Shorncliffe branch. In 2019, Hitachi Rail was selected as the ETCS L2 supplier and integrator.

The project is using Queensland Rail's 1800MHz spectrum licenses to provide a safety-critical data radio system for the ETCS L2 signalling system ETCS L2, which will modernise the SEQ passenger rail network by replacing legacy coloured light signalling systems with a modern digital in-cab signalling system. ETCS L2 allows trains to run closer together, while adding a layer of safety over existing legacy systems. This provides many benefits, including substantial cost savings as more trains can be run on existing rail lines and corridors, reducing the reliance on acquiring additional land and/or build additional tracks and increasing capacity of the rail network with more frequent services and less waiting times. The data radio system is using GSM-R technology with GPRS as the standard for data transmission.

The data radio system utilises additional 1800MHz spectrum to provide mobile data for Automatic Train Operation (ATO). ATO is being implemented in the Cross River Rail (CRR) tunnel to enable the trains to top at precise locations at station platforms. This will ensure the train doors align with Platform Screen doors being implemented at each underground station. The alignment is essential to ensure the safety of customers as they board and depart trains in the underground station platforms.

Additional GSM-R infrastructure has been installed in rollingstock maintenance facilities at Redband and Wulkuraka to allow the testing of onboard ETCS equipment for certification of installation and maintenance activities.

Based on 2G technology, the data radio system is susceptible to interference from MNO services operating 3G, 4G and 5G technologies adjacent to or near the rail corridor. This is a well-documented and known issue. To minimise the risk and impact of interference, additional 1800MHz spectrum has been reserved to provide guard bands between the rail and MNO systems.

As part of the ETCS L2 Inner City project, the GSM-R system will also provide mobile data for handheld possession terminals. These terminals allow protection officers to take possession of an area of track for maintenance or construction purposes. Once possession has been granted no other rail traffic can enter that area until the possession

has ceased. This is a critical safety system used to protect track workers, construction and maintenance personnel from moving rollingstock.

Finally, with the impending obsolescence of GM-R technology, additional 1800MHz spectrum has been reserved to allow the migration to modern 5G technology while maintaining services on the 2G GSM-R network.

Planned Use

The initial rollout of ETCS L2 takes in the geographic areas on the Shorncliffe rail line and the CRR underground tunnel with minor extensions past the tunnel portals to enable trains to transition from conventional signalling to ETCS L2.

- **GSM-R Projects (1800MHz Spectrum)**

There are several projects in various stages of planning and implementation to extend ETCS L2 to the south and north or Brisbane. With limited time before the 2032 Olympics, Immaturity of FRMCS standards and products, the decision has been made to extend GSM-R technology to parts of the Qld Rail passenger rail network.

- **Southern Portal to Salisbury (under construction)**

State of the art train signalling system set to expand under State Budget - Ministerial Media Statements

This will provide ETCS L2 operation to the rail line south of the CRR tunnel towards Salisbury. This extension will provide a transition zone to enable trains to change from conventional signalling to ETCS L2 seamlessly and at line speed in preparation for travelling through the CRR tunnel. This project is presently being implemented. A number of GSM-R sites are being constructed in readiness for testing and commissioning.

- **Logan to Gold Coast Faster Rail (out to tender, commence construction 2025)**

Logan and Gold Coast Faster Rail | Department of Transport and Main Roads (tmr.qld.gov.au)

This project will extend ETCS L2 further south from Salisbury to Varsity Lakes. Again, GSM-R over 1800MHz spectrum is the chosen technology due to FRMCS standards and equipment not available in time.

Upon completion, these projects will see GSM-R (1800MHz) deployed along the entire southern passenger rail line from Brisbane to Varsity Lakes (Gold Coast).

Evolving use of the spectrum over the current and potential future license term

- **FRMCS (1800MHz and 1900MHz)**

In alignment with GSM technology obsolescence, it is expected vendors will be unable to maintain support for GSM-R technology much beyond 2030 and in some cases, 2035 pending specific vendor contracts and capability. As such, Queensland Rail will be transitioning to FRMCS at a time when standards are stable, and products are more widely available. FRMCS will be initially delivered over 5G technology, which opens up a number of new use cases available

to the railway industry that has not been previously possible using 2G GSM-R technology. As part of the development of FRMCS, the International Union of Railways (UIC) have been developing a set of use cases for FRMCS.

Among the use cases are critical applications that are essential for train movements and rail safety, such as emergency communications, Automatic Train Protection (including ETCS and CBTC), Automatic Train Operation (ATO), trackside possession terminals, trackside monitoring, monitoring and control of critical infrastructure and critical real-time video.

Like other states that have implemented GSM-R and are facing obsolescence issues, Queensland Rail and the Department of Transport and Main Roads (TMR) are considering FRMCS as a replacement technology. This project is in the early feasibility stage but expected to be fast tracked to implement FRMCS for the Direct Sunshine Coast Railway. While the primary focus will be to support the use cases provided by GSM-R, other use cases will be explored but are yet to be finalised. Queensland Rail and TMR are monitoring developments both overseas and locally. Of particular interest, is the implementation of an LTE system in Perth as part of PTA's radio upgrade project and their use cases involving critical real-time video for staff and customer safety.

Critical real-time video could be used to ensure passenger safety for platform screen door operation in the Cross River Rail underground stations.

New use cases such as critical real-time video are bandwidth intensive. Early desktop studies are indicating that FRMCS over 1900MHz will not have sufficient capacity to support some of these new critical use cases. As such, 1800MHz spectrum will need to be retained to provide additional capacity to meet these use cases. Refer to Appendix A for recent spectrum modelling that identifies this shortfall.

- **Operational Voice**

As part of the initial business case for ETCS L2 in SEQ, the GSM-R system was to also provide operational voice communications to replace an ageing UHF analogue system. Delays to business case approval together with 400MHz narrow banding mandates, resulted in the implementation of a DMR Tier3 digital voice solution in the 400MHz RIO band. This project was finalised in 2018.

However, as part of FRMCS implementation together with the initiatives of the National Transport Commission to ensure rail control systems are interoperable and/or harmonised, Qld Rail & TMR will explore the implementation of operational voice over FRMCS. Qld Rail are aware of products available today that can operate over Digital mobile radio technologies such as P25 and DMR as well as 3GPP Mission Critical (MCX) standards over 4G/5G technologies.

FRMCS Projects (1800MHz & 1900mHz spectrum)

- **Direct Sunshine Coast (DSC) Rail line (Beerwah to Maroochydore)**

https://www.tmr.qld.gov.au/projects/direct-sunshine-coast-rail-line-planning

In terms of Spectrum, the DSC project is a special case where lack of access to 1800MHz spectrum will require the implementation of FRMCS over 1900MHz spectrum. In comparison to the southern line, this new line will not have access to 1800MHz spectrum and therefore cannot implement GSM-R as it will not operate over 1900MHz TDD spectrum.

FRMCS is to be implemented for ETCS L2, ATO, handheld possession terminals and future voice and video.

- **GSM-R Migration**

To mitigate the risks of obsolescence, FRMCS will be extended to replace GSM-R technology implemented in the CRR tunnel and to Varsity Lakes. It is expected this work will commence after the 2032 Olympic and Paralympic Games and take approximately 4 years to complete. An earlier than anticipated end of product support could bring this work forward.

- **FRMCS future rollout (1800MHz and 1900MHz)**

Post the 2032 Olympics, it is expected FRMCS will expand to other parts of the SEQ passenger rail network. The major drivers being replacement of legacy signalling system with ETCS L2, public transport demands, alignment to National Interoperability and Harmonisation initiatives and rail network expansion.

- **Third - party or sharing arrangements currently in place or under active consideration, including those that may be in place with another spectrum licensee**

Queensland Rail presently does not have any third party or sharing arrangements in place with regards to its 1800MHz spectrum licenses. Queensland Rail has previously shared 1800MHz spectrum with an international Airline Carrier for a trial of onboard mobile phone services for customers. Queensland Rail has also explored sharing arrangements with a local manufacturer of rail communications systems, for testing and development of cab radio solutions. Queensland Rail is open to explore spectrum sharing arrangements with third parties, provided there is no impact to current and future it can ensure safe and efficient rail services.

- **Anticipated trading or acquisition of spectrum through the secondary market**

Queensland Rail presently does not anticipate any spectrum trading or acquisition of spectrum through the secondary market.

- **Issues with current planning, licensing or technical arrangements that prevent efficient use of the spectrum**

Queensland Rail wishes to point out the geographic footprint of current 1800MHz spectrum licenses fall short of the northern boundary of the SEQ passenger rail network. In the past Queensland Rail attempted to acquire spectrum through the auction process but found the final purchase price significantly greater than the amount the organisation originally budgeted for and was willing to pay. This provides evidence that government organisations cannot compete with commercial operators for spectrum licenses in the open market. Queensland Rail will be reliant on securing access to 1900MHz spectrum to cover this part of the rail network. However, this creates an issue with insufficient

spectrum to enable seamless migration to future technologies beyond FRMCS (5G) and additional capacity for higher bandwidth applications.

Public interest criterion 2: promotes investment and innovation

How does your current and planned use of the spectrum promote investment and innovation?

As discussed above, there are a number of Rail projects on the SEQ passenger Rail network relying on access to 1800MHz spectrum. These projects will implement modern digital signalling systems, replace legacy signalling systems allowing trains to safely run closer together, increasing the capacity of the rail network. These capacity increases are essential to meet demands for public transport for the upcoming 2032 Olympic and Paralympic Games as well as projected population growth over the next decade.

- **Cross River Rail**

https://crossriverrail.qld.gov.au/about/project-benefits/#economic

1800MHz spectrum is being used to implement ETCS L2 signalling for the Cross River Rail tunnel.

Cross River Rail presents opportunities for urban renewal and precinct development at major station locations including Boggo Road, Woolloongabba, Albert Street, Roma Street and Exhibition.

High-level estimates suggest that this precinct activation could have direct and indirect economic benefits of up to $15 billion to $20 billion per annum of Gross State Product (GSP) over a 20 to 30-year timeframe, while creating up to 35,000 jobs.

Cross River Rail is a second river crossing at the core of the rail network with capacity to run as many as 24 trains in each direction. Not only does this enable increased frequency of trains across the whole of South East Queensland, a second rail path through the CBD will reduce congestion on our roads, increase network reliability and improve rail as a customer experience.

Cross River Rail will improve journey times for commuters, sports fans, shoppers, health workers and students.

- **ETCS L2 Expansion**

State of the art train signalling system set to expand under State Budget - Ministerial Media Statements

The project will expand the installation of ETCS L2 from the Cross River Rail Tunnel to Moorooka, replacing legacy signalling systems that are approaching obsolescence. ETCS L2 will allow trains to operate closer together, increasing capacity and reliability of the rail network, providing more services and reduce waiting and travel times for customers.

ETCS L2 relies on 1800MHz spectrum to provide the Data Radio System based on GSM-R technology.

This forms part of a rolling program to expand ETCS L2 throughout the SEQ passenger rail network. It also forms part of a larger plan to expand rail services direct to the sunshine coast. Project funding for the expansion project amounts to $554 million, increasing the investment in ETCS to a total of $1.318.3 billion at that point in time.

- **LGCFR**

Logan and Gold Coast Faster Rail | Department of Transport and Main Roads (tmr.qld.gov.au)

The Logan to Gold Coast Faster Rail Project will increase the capacity of the Gold Coast rail line, providing more frequent and reliable rail services, reducing wait times at stations between Brisbane and the Gold Coast. The total investment amounts to $5.75 billion, providing many benefits including improved efficiency and capacity, reduction in travel and waiting times and contributing to regional growth and the economy.

The project is reliant in 1800MHz spectrum, which will be used to implement a GSM-R based data radio system, an essential part of new signalling technology (ETCS L2) being implemented between Salisbury and Varsity Lakes.

Construction works is expected to commence from 2025.

- **ETCS and FRMCS**

Post Olympics GSM-R implemented on the CRR and southern line is to be replaced with FRMCS to manage technology obsolescence. FRMCS will not only provide the capacity for existing use cases provided by GSM-R but will open up many more enabling the railway to move towards a digital future. Digitising the railway will provide many benefits, including better asset utilisation and maintenance, informed forecasting, improved planning, streamlining maintenance processes, cost savings and improved customer and staff safety. Queensland Rail recognises that the list of use cases is still being developed and will further evolve over time, but based on what is known today, it is envisaged both 1800MHz and 1900MHz spectrum will be required to provide the capacity to achieve these benefits.

Public interest criterion 3: enhances competition

How does your current and planned use of the spectrum enhance competition?

Both GSM-R and FRMCS are based on International 3GPP standards, leveraging technology development and innovation from the commercial sector and the larger European rail industry.

1800MHz spectrum has been standardised internationally to support 2G, 4G and 5G technologies providing the rail industry with a competitive source of equipment from multiple vendors and not having to rely on bespoke products or sole suppliers.

Ongoing access to 1800MHz spectrum will allow Qld Rail to offer more frequent services on it's rail network through the implementation of ETCS L2 technology, providing additional competition and choice to other modes of transport.

Rail plays a crucial role in providing an environmentally friendly mode of transport and helping the nation achieve its goals in reducing the overall carbon footprint and Net Zero targets.

Public interest criterion 4: balances public benefits and impacts

How does your current and planned use of the spectrum balance public benefits and impacts?

By 2036, the population of South East Queensland is forecast to reach almost 4.9 million people. By 2046, this is projected to increase to 6 million. This will place increasing pressure on our transport system, particularly in growth corridors and where the system converges in the Brisbane CBD.

https://www.tmr.qld.gov.au/travel-and-transport/rail/south-east-queenslands-rail-horizon

In 2032, Brisbane will host the Olympic and Paralympic Games. This is a major event that will bring in thousands of visitors from all around the world. With such a large influx of people, it is important to have a well-planned public transportation system in place to ensure that attendees can easily and efficiently get to and from the venues and other parts of the city.

The 2032 Games infrastructure works program will accelerate the delivery of long-term plans for the public transport network and infrastructure, that will meet the needs of the growing population in South East Queensland, benefiting Queenslanders for decades to come.

By 2032, the transport corridors connecting the three Games zones across South East Queensland will have increased rail capacity, connecting major tourism hubs on the Gold Coast, Sunshine Coast and Brisbane.

1800MHz spectrum is essential to the delivery of these rail transport upgrades through the implementation of a modern ETCS L2 signalling system. Without 1800MHz spectrum, the state government would not be able to provide the necessary upgrades and new rail networks to meet the transport needs of the 2032 Games and future population growth.

Public interest criterion 5: supports relevant policy objectives and priorities (including regional, rural, and remote connectivity, investment and competition)

How does your current and planned use of the spectrum support regional, rural, and remote connectivity, investment and competition?

1800MHz spectrum is essential to the state government's plans to implement ETCS L2 on existing and new rail lines providing a safe and efficient public transport service connecting the major regional centres of the Gold and Sunshine Coast to support the 2032 Olympic and Paralympic Games and future public transport needs of SEQ.

The SEQ passenger rail network also supports freight and long distance passenger services connecting regional and remote parts of Qld.

Through the implementation of ETCS L2 over 1800MHz spectrum, the provision of public transport services aligns with national policy objectives providing economic, social and environmental benefits.

Appendix A - FRMCS Coverage modelling

Early coverage modelling carried out as part of FRMCS early works is indicting that 1900MHz spectrum alone will not have the capacity to support higher bandwidth applications such as critical real-time video.

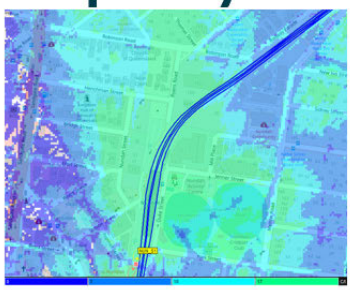
Modelling outcomes

Application	User Equipment Receiver	Normal Mode	Single Failure Mode
ETCS+ATO	Train rooftop antenna (4 m AGL)	100%	100%
Voice (MCPTT) Cab Radio	Train rooftop antenna (4 m AGL)	100%	100%
Voice (MCPTT) Handheld	Handheld (1.5 m AGL)	100%	~90%
ETCS Possession Terminal	Handheld (1.5 m AGL)	100%	~75%
CCTV (1 Camera)	Train rooftop antenna (4 m AGL)	~80%	~40%
CCTV (4 Cameras)	Train rooftop antenna (4 m AGL)	~30%	~15%

The percentages represent the rail corridor area where each application can be fully supported with guaranteed Quality of Service.
These numbers represent worse-case scenarios of maximum number of users in the cell edge.

The table above identifies gaps in areas where high bandwidth applications like video cannot be supported throughout the entire coverage area when using 1900MHz on it's own in both normal and degraded mode.

Capacity – 1900 TDD vs 1900 TDD & 1800 FDD



Applications	1900 10MHz TDD Load	1800 15MHz FDD Load
ATO/ETCS, MCPTT, HHT	35%	N/A
ATO/ETCS, MCPTT, HHT, 1 CCTV	63%	N/A
ATO/ETCS, MCPTT, HHT, 4 CCTV	148%	N/A
ATO/ETCS, MCPTT, HHT, 4 CCTV (3 RF Zones)	114%	N/A
ATO/ETCS,MCPTT, HHT, 1 CCTV + 4 Add CCTV	63%	38%
ATO/ETCS,MCPTT, HHT, 1 CCTV + 8 Add CCTV	63%	74%
ATO/ETCS,MCPTT, HHT, 1 CCTV + 10 Add CCTV (3 RF Zones)	63%	71%

General:
- SINR is the reference signal which correlates with capacity. Total cell capacity depends on the SINR experienced by each UE
- Allowing the network to be loaded above 75% severely impacts cell edge SINR
- Achieving 3-4dB SINR as the worst "cell edge" condition can be challenging
- Any user traffic in areas of low SINR must be offset with user traffic being served in proportionately higher SINR to maintain overall capacity
- If UE distribution can be "guaranteed" then capacity design can be split into zones to allow for higher overall application numbers / throughput

1900 MHz TDD Only:
- Single zone calculations assume cell edge RF conditions achieve 3dB SINR
- Zoned SINR Considered:
  - Edge 3dB
  - Mid Cell 10dB
  - Near Cell 17dB
- Four scenarios considered:
  - ATO/ETCS, MCPTT, HHT
  - ATO/ETCS, MCPTT, HHT, 1 CCTV
  - ATO/ETCS, MCPTT, HHT, 4 CCTV
  - ATO/ETCS, MCPTT, HHT, 4 CCTV Split into 3 RF Zones (50% Edge, 25% Mid Cell, 25% Near Cell)

1900 MHz TDD and 1800 MHz FDD:
- Extra spectrum in 1800 can be used to augment the 1900 network
- It is assumed that ATO/ETCS, MCPTT, HHT and 1 CCTV will stay on the 1900 network, load <75% to maintain edge RF of 3dB SINR
- RF Zone SINR Considered:
  - Edge 3dB
  - Mid Cell 10dB
  - Near Cell 17dB
- Three scenarios considered:
  - 4 additional CCTV Single RF Zone
  - 8 additional CCTV Single RF Zone
  - 10 additional CCTV Split into 3 RF Zones (50% Edge, 25% Mid Cell, 25% Near Cell)

The slide above shows that with the addition of 15MHz of 1800MHz FDD spectrum, FRMCS network load is able to be managed to provide critical real-time video while not impacting cell edge SNR and performance of services such as ETCS, ATO, voice and handheld possession terminals.

South Australian Public Transport Authority (SAPTA)

The South Australian Public Transport Authority (SAPTA) division within the Department for Infrastructure and Transport (DIT) is responsible for ensuring the integrity of a diverse portfolio of rail assets worth over $2.7 billion on behalf of all South Australians. These assets are located within the Adelaide Metropolitan Passenger Rail Network (AMPRN), which is comprised of the Seaford, Flinders, Gawler, Outer Harbor, Grange, Port Dock and Belair lines (train network), and the Glenelg, Hindmarsh, East Link and Festival Plaza lines (tram network). It includes a diverse range of public transport assets including track, signals, communications, stations and stops, traction systems, overhead wire, civil structures and rolling stock.

The train and tram assets are operated and maintained by Keolis Downer Adelaide (KDA) and Torrens Connect (TC) respectively under separate contractual arrangements. The service providers hold accreditation under Rail Safety National Law (RSNL) as Rail Transport Operator as both Rolling Stock Operator and Rail Infrastructure Manager for the purpose of operating and maintaining and are responsible for managing the assets in accordance with their contractual requirements.

DIT, on behalf of the South Australian government has renegotiated these operating contracts to bring the control of trams and trains back into government hands. From February 2025 the train network will continue to be maintained by KDA, but the Rail Commissioner will be the accredited Rail Infrastructure Manager and Rolling Stock Operator. From July 2025 the tram network will continue to be maintained by TC, but the Rail Commissioner will be the accredited Rail Infrastructure Manager and Rolling Stock Operator.

Context

DIT uses the SAGRN network as its primary voice communications for safety critical related communications with train and tram controllers, train and tram drivers, security staff and maintenance crews, including with emergency service respondents via shared “interoperability” talk groups on Adelaide’s Rail System.

The SAGRN is a whole of Government shared network, comprising a Motorola (Astro) P25, providing outdoor coverage over approximately 96 percent of the State’s populated areas.

There are more than 20 different agencies being served by SAGRN. The SAGRN is provisioned for high traffic events, however, it cannot satisfy demand when traffic exceeds its capacity, or when high levels of traffic are presented because of inefficient radio practices. The policy for SAGRN use prioritises emergency services agencies in the event of major incidents. When traffic demand is high, agencies such as DIT will be dropped off. DIT will revert to the backup radio communication.

The secondary system used by DIT Rail is City Vote “Broadcast” conventional analogue radio system. The City Vote system provides contingency support when the SAGRN system is unavailable, including during planned SAGRN outages. This system has entered its end of life support as defined by the manufacturer.

Reliable radio communication is a requirement of DIT’s rail accreditation, trains and trams are not permitted to operate without radio communications.

SAPTA currently holds spectrum license in the 1800MHz spectrum band (license 9460456)

DIT does not have any third party or sharing arrangements in place with regards to its spectrum license, however, SAPTA is open to exploring sharing arrangements that maximizes public benefits while ensuring safe and efficient rail operation.

How has SAPTA progressed towards utilising its 1800 MHz spectrum

DIT has implemented ETCS - L1 on 2 of the Metro Lines Seaford and Gawler and an Overlay ETCS – L1 on the Belair line.

DIT currently is in the process of developing business cases for replacement of aging rolling stock, upgrade to the Train Control System and ageing signalling systems on the Outer Harbour, Grange and potentially the Belair Line.

Strategic alignment between the rolling stock on-board system, train control system and wayside signalling will be an important factor in the technology being considered including the alignment to the National Train Control approach to implement ETCS – L2 as the minimum standard.

Train Control System – L2 is a communication-based train control system, ensuring sage communication with onboard systems.

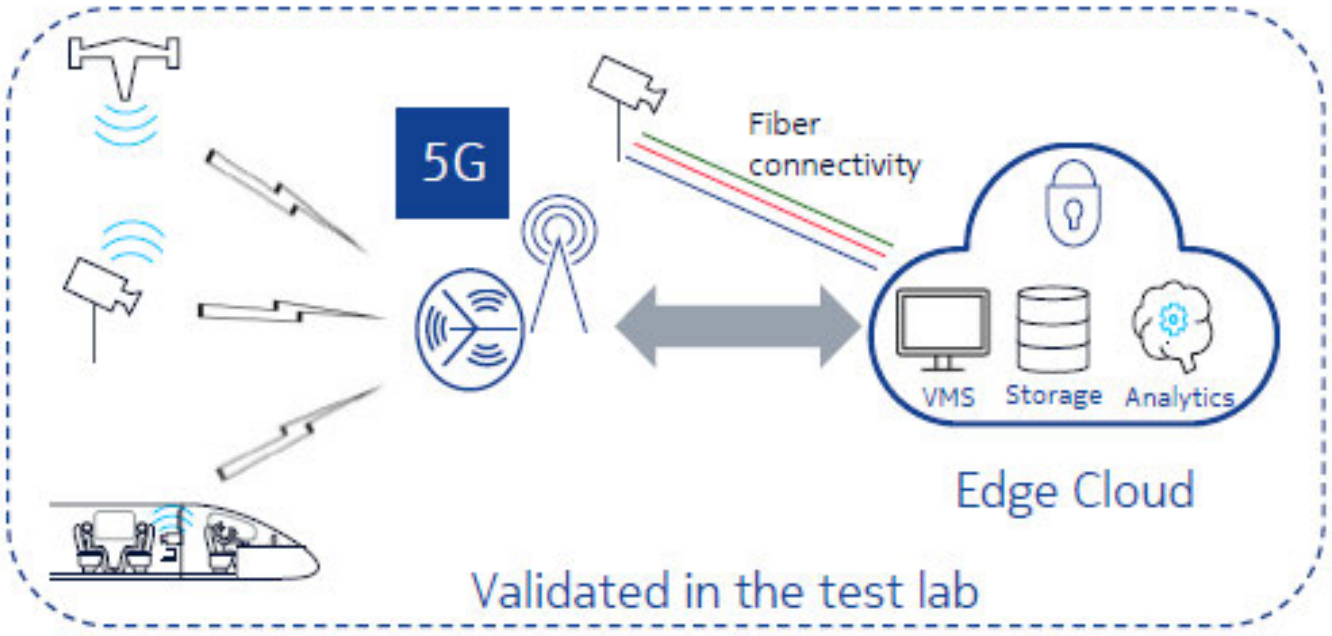
The 1800 MHz Spectrum is critical to enable DIT to deliver future rail safety systems on a modern and single communications platform across its network; as well as enabling support functions across the enabling assets such as journey information and ticketing. This further articulates the State Government’s priorities to increase the use of public transport and increased customer satisfaction, and DIT’s policy to maximise the use and return on its infrastructure.

DIT participated in the 5G Innovation program and partnered with a specialist consulting firm in 2022 for trialling DIT rail safety use cases.

The use case was a pilot to use 5G communications on the AMPRN to enable live rail and light rail CCTV streaming for situational awareness inside passenger comportments back to the rail control centre.

Outcome of the trial on the use case were positive with a range of technical assessments including the RF capacity and bandwidths requirements confirmed in the trial.

Further to the 5G Innovation Program trial, DIT will be exploring the use case further and expanding the test criteria to unlock further functionality as a tool to Safety, Productivity and Efficiency uplifts in railway initiatives.

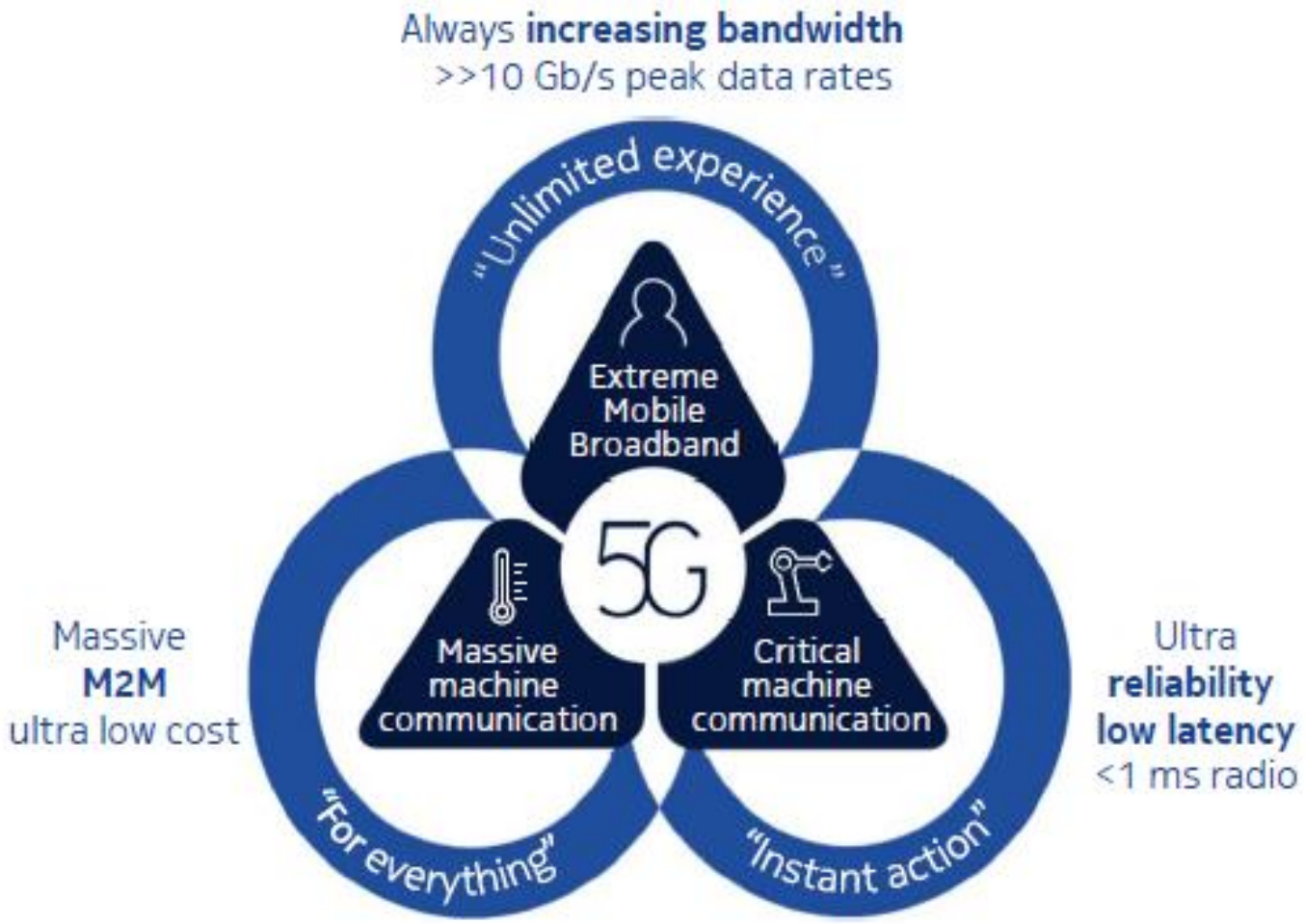


Future Railway Mobile Communication System (FRMCS) is the successor of GSM-R, designed for all railways and the evolution from GSM-R to 5G enabled use cases. As part of DIT's 5G innovation program, a study specific to the FRMCS was conducted, identifying the key requirements:

- Critical communication to further increase operational efficiency, improve customer experience and automation for railway
- Performance communication to identify systems and sub-systems and applications ability to unify network technology, reduce complexity and increase flexibility
- Business communication, where DIT anticipate this is a result and benefit that could be derived or unlocked from the key requirements above, for increased customer safety and experience such as emergency phone, help points, with ability to long term support to ETCS systems and management of technology obsolescence.

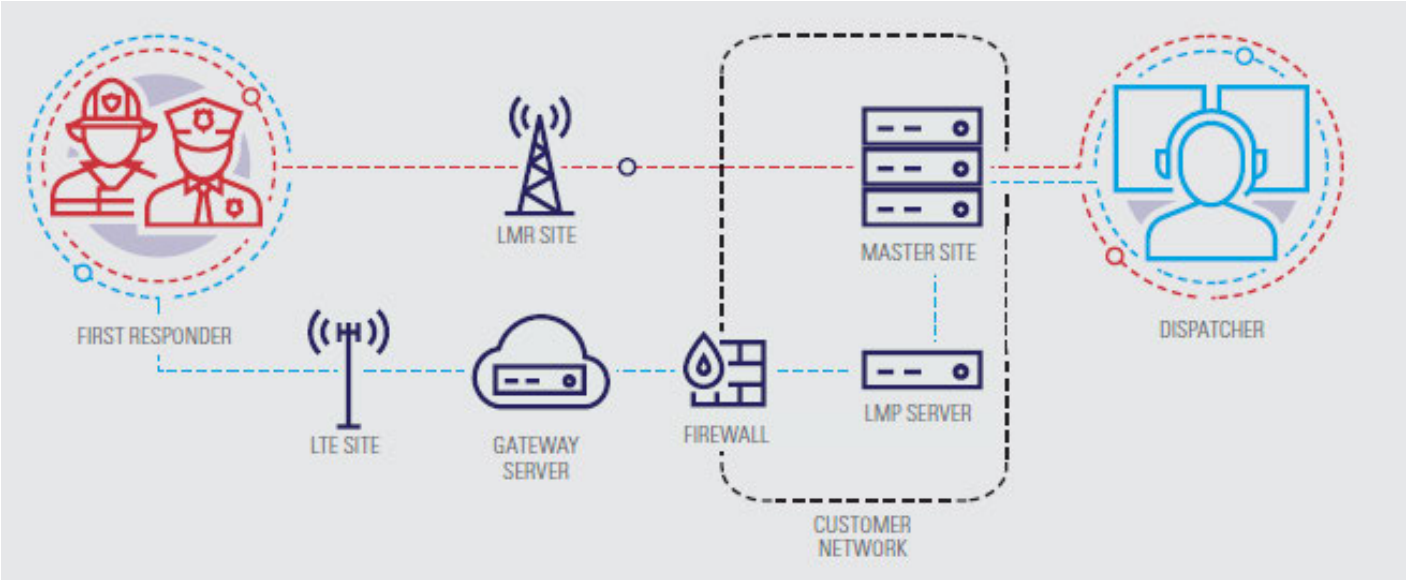
As part of the development of FRMCS, DIT closely participate for updates and developments by the International Union of Railways (UIC) and National Transport Commission (NTC) within FRMCS realm, ensuring standard and industry harmonisations and systems' interoperability.

It is imperative the access to 1800MHz spectrum will allow DIT to trial and accelerate adoption of FRMCS applications in South Australia.

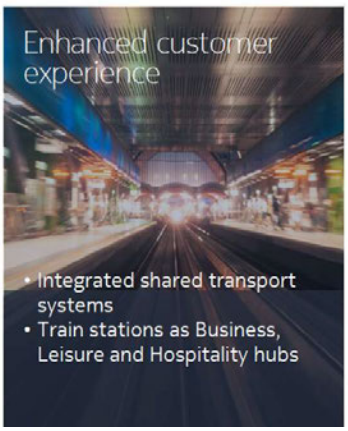


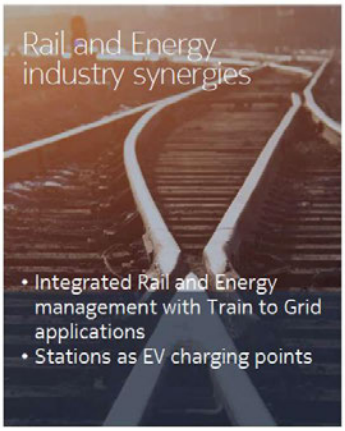
DIT will be upgrading its aging 400MHz radios over the next three (3) financial years, with an approved funding, with view to progress with digital mobile radio technologies with ability to fall back to broadband and LTE based system, as its backup system. There are currently 2200 radios in service across the Department that are due for upgrade with an additional 400 units to be purchased.

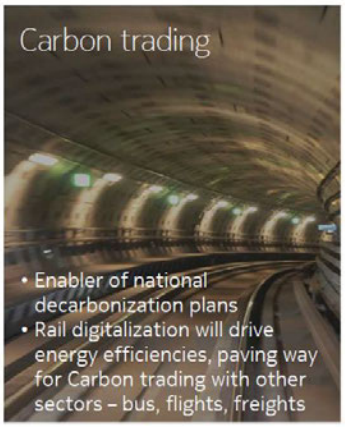
In addition to the radio upgrade, DIT is exploring and investigating alternatives with its service provider for the replacement of aging radio backup systems over digital technologies as well as 3GPP Mission Critical (MCX) standards over LTE based system.



With the spectrum access, it will allow DIT to unlock digital values with avenue to explore models and innovations which mandates real-time, low latency communications:







Future Projects

Further to discussion above, DIT will be upgrading its aging radios across all fleet with anticipation to upgrade with functionality to backup to broadband or LTE based technology in the rollout.

DIT are also investigating the ability to use modern digital communication systems across various rail operational crews to improve rail safety and day to day operations when issuing work authorities and improving efficiencies.

Public Transport Authority Western Australia (PTA WA)

PTA Introduction

The Public Transport Authority of WA is the sole Passenger Rail Provider in the WA Metro.

It both maintains and operates passenger rail services across 6 rail lines extending across the Perth Metro area.

The PTA rail network is currently undergoing significant expansions through the Metronet programme and by completion the PTA rail network will comprise of 87 Rail stations and approximately 240km of electrified railway servicing approximately 59M passenger journeys a year.

In addition to passenger services the PTA has multiple sections of shared freight usage corridor.

The PTA owns and operates a centrally controlled rail network and manages all aspects of the operations and maintenance of this railway.

Unique to PTA this also includes a private security team with powers of arrest with PTA rail land.

To support both Train Operations and Railway Security the PTA owns and operates a Train control and security radio system.

The current Radio system was installed in the early 1990's and operates in the 400MHz band spread over 53 transmission sites. It reached its effective life in the mid 2010s.

The PTA currently holds spectrum licenses in the 1800MHz spectrum band (licenses 9263461 and 9367781) and is in progress with a Radio System Replacement Project that is delivering a 3GPP based LTE system that will replace the existing PTA radio system.

How has PTA progressed towards utilising its 1800MHz spectrum

The PTA began the journey to replace its aging 400MHz radio system in the early 2010's with an approved business case in 2015 that recommended progressing with a LTE based system leveraging the recently (2013/14) acquired 1800MHz spectrum.

The requirement was identified for both a voice and data capable network to support One to Many and One to One communication, primarily for use by Train Drivers back to central train control and Transit Officers back to Shift Command but also for use by any rail safety and station staff working near the operating railway.

Clear communication from field to control is vital in safe operation of a Railway and the new system was to provide a huge improvement in quality and flexibility of the system.

In addition to Personnel communication, the forward look ahead was that PTA also needed a Data transmission platform to provide Train to control data communications. This was desired to enable future on board technologies such as in cab signalling, rail car telemetry and CCTV vision.

On approval of the business case the PTA created the Radio System Replacement (RSR) project which eventually went to a competitive and interactive tender in 2017 and awarded a Design Build and Maintain contract with Huawei and UGL in July 2018

The project had an expected commissioning date in 2021 and was well underway in both design and portions of construction (multiple new towers on the Airport line and co-located freeway sites with Main Roads WA) when in March 2020 the PTA was forced to abandon the contract with Huawei and UGL due to the US trade restrictions on Huawei whereby it was no longer able to comply with critical portions of the contract. A new arrangement was discussed with the termination made effective in Sep 2020.

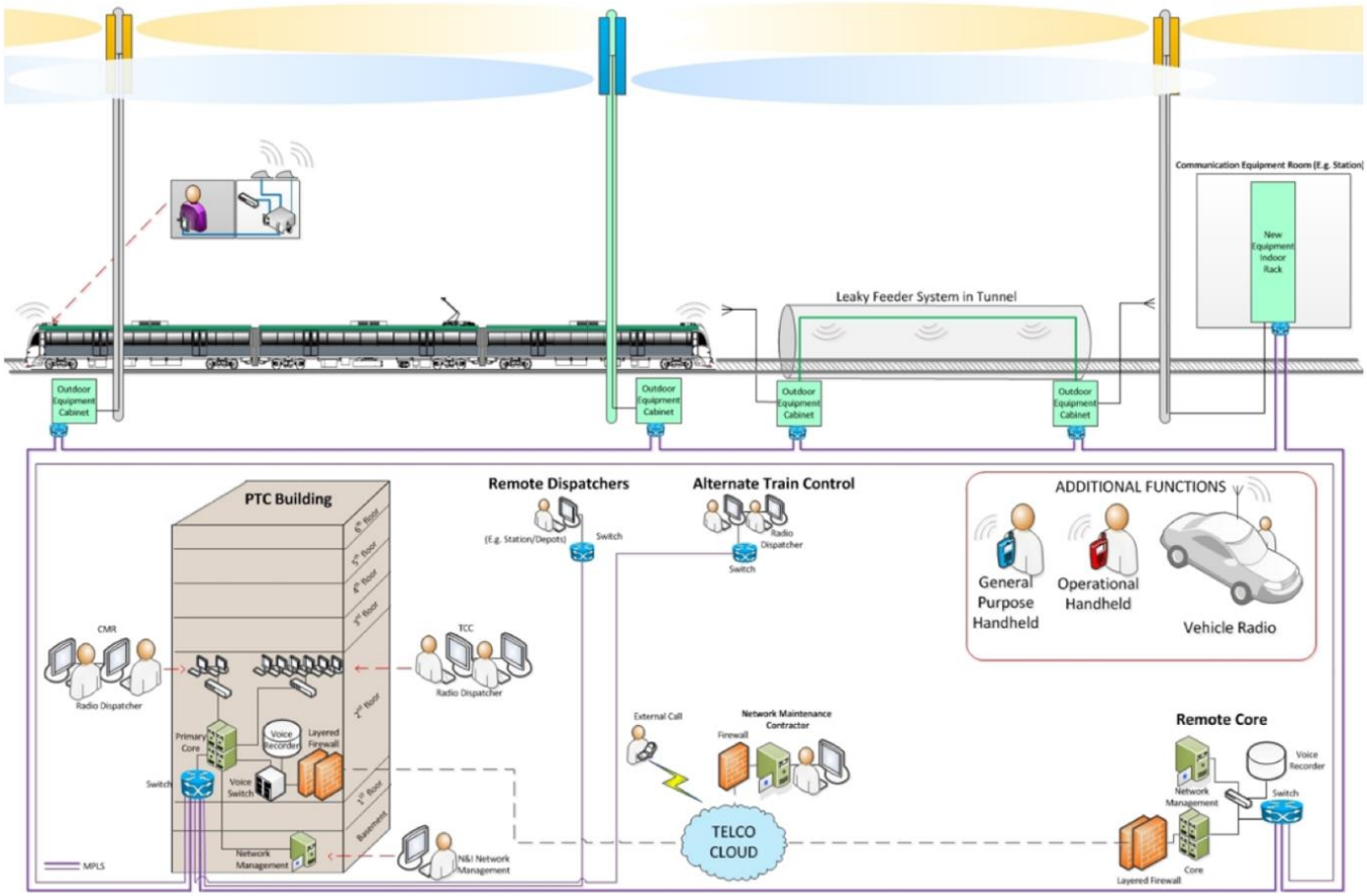
After a re-evaluation of the market it was decided to break the new procurement into skill based contracts with a single technology contract for the MPLS and LTE portion plus multiple other contracts for Monopoles, power, fibre etc.

A closed interactive tender process for the technology scope started in Sep 2020 with a Design, Construct and Maintain contract being awarded to Nokia in December 2021

The remaining scope was broken down into multiple packages with the next largest being awarded to UGL in December 2022 for the Design and Construction of the Monopoles and all Civil, Electrical and Communications works required for the radio sites.

These contracts are now well underway with construction and installation and it is expected that system testing and commissioning will commence in early 2025 with the system entering full system stability testing by close of 2025.

The LTE system being delivered for the PTA will comprise approximately 100 new radio sites, 200+ new cabinets and equipment racks, nearly 8km of new pit and pipe cable route and over 100km of new fibre. The WA government has invested hundreds of Millions into this network with the minimum expectation of a 15 year service life and for it be the platform to support future projects



What is in progress

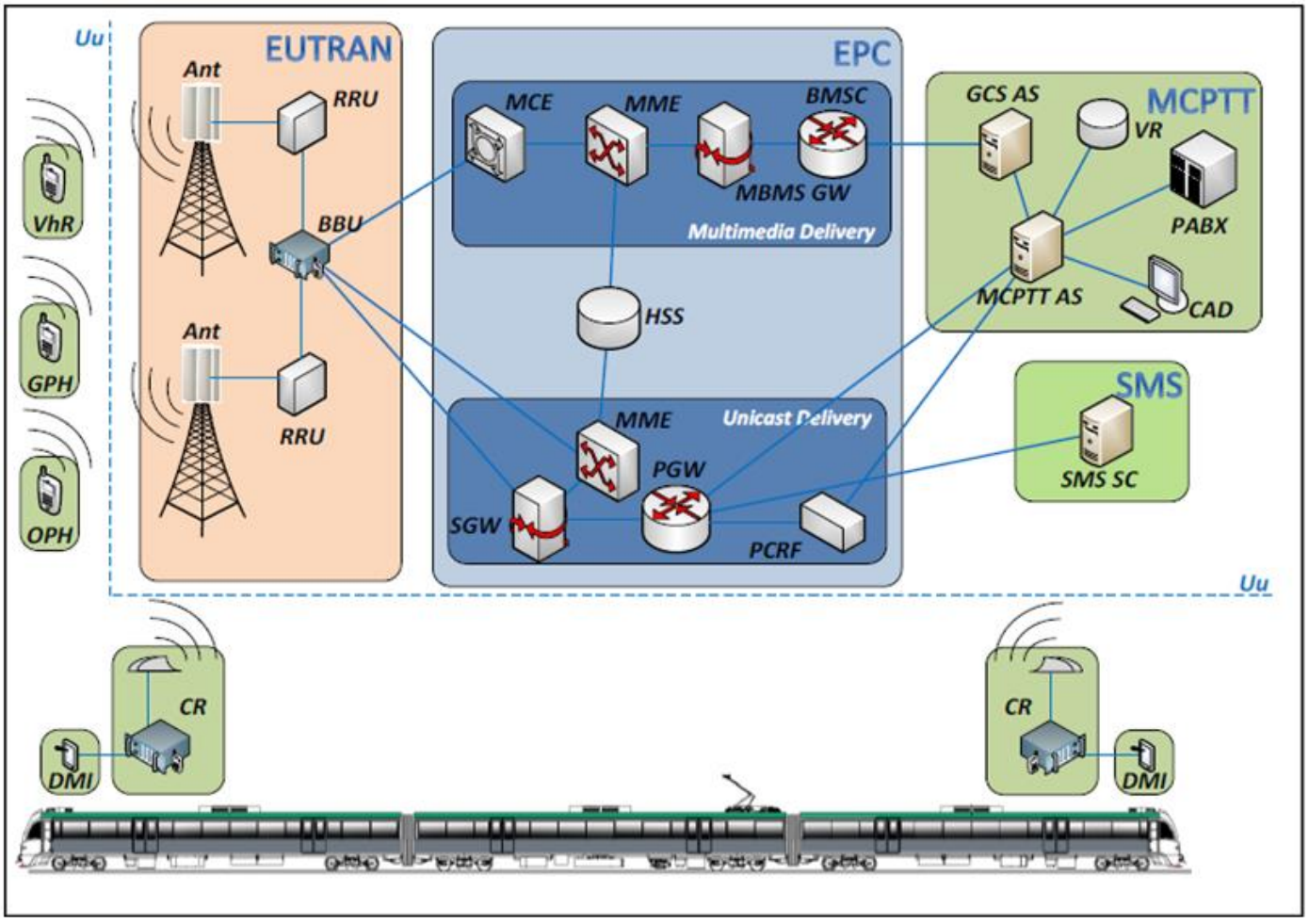
In addition to the roll out of the LTE system itself the PTA and the WA government has as of June 2024 executed a contract with Alstom and DT Infrastructure for the delivery of the WA High Capacity Signalling Project.

The HCS project is a $1 Billion + project that will over a period of up to 10 years replace the entirety of the PTAs Field Signalling and Train Control System. It will transition PTA to a Communications Based Train Control System (CBTC) (PTA are implementing Grade of Automation level 2 (GOA2), Semi-automated train operation, in accordance with IEC 62290.) This will remove much of the physical lineside signalling equipment and physical track based train detection and instead moves to reliance on wireless (LTE) communications between train and central control for the safe and efficient movement of passenger trains across the PTA network. The PTA CBTC system is also expected to have a 15 year service life from delivery completion, pushing minimum asset life into the mid 2040's

This project will provide PTA with multiple benefits.

- Replacement of aging signalling assets (of most importance the 1990's installed Automatic Train Protection system)
- Improved efficiency and capacity of train lines (needed to meet 2031 predicted rail utilisation growth)
- Reduction of line side assets to maintain

The heart of this project is the RSR delivered LTE system that will provide the backhaul transmission network (MPLS) and radio access network (LTE) to enable field devices, central train control and Railcars to all reliably communicate safety critical and time sensitive information between each other. In consultation with system suppliers, the PTA has specified the required performance criteria for the radio access network and the backhaul transmission network in the RSR contract, to enable safe and successful operation of a CBTC system on the PTA rail network. These two projects are effectively linked and any changes or delays to the RAN will result in significant impact on the CBTC system delivery.



Future Projects

In addition to the two major project RSR and HCS there are other smaller initiatives that intend to utilise the Radio Access Network provided by the RSR project.

Driver Assist Video System (DAVS) - the PTA currently operates a DAVS system that streams video footage from platform based CCTV cameras to the Drivers CAB screen upon train arrival at a station platform. This system used to operate in free to air TV spectrum and then transitioned to WiFi in the mid 2010's. The performance of this system requires significant upkeep and is prone to interference and also requires the upkeep of a relatively complex network configuration. PTA intends to transition the radio path of this system away from WiFi and utilise the RAN.

Long Line Public Address (LLPA) interface - the PTA intends to leverage the LTE Handsets to interface as roaming microphones to allow Station and Security staff to make operational announcements from handset to the Station LLPA system. This would enable operational flexibility and the decommissioning of location specific digital radio handsets currently in use across the PTA stations.

On Board CCTV - the PTA currently utilises station and depot based WiFi in order to retrieve CCTV footage from some rail cars, other rail cars still require physical removal of hard drives to access footage. Both of these methods are slow and operational cumbersome and also mean that it can take longer than needed to gain footage for active investigations and live monitoring is not possible. PTA have designed the RAN with some capacity for Live streaming and queued retrieval of footage from rail cars, improving the PTAs ability to monitor trains and conduct security investigations in a timely manner.

Line side device connectivity - the PTA has many small logging devices that currently utilise carrier data sims. It is PTAs intention to over time migrate these services onto the PTA LTE network to both maintain full control of these devices, minimise cost and reduce cyber threat vulnerabilities.

What PTA sees the future looking like

The RAN utilising the 1800MHz spectrum is currently expected to be in use for no less than 15 years from final asset acceptance for both the RSR and HCS projects, it needs to be specifically designed and maintained to support the PTAs mission critical voice and CBTC system. A move to less or different spectrum would significantly impact PTAs ability to deliver on its current commitments and has been investigated to likely mean requiring abandonment of some (such as on board CCTV) PTA does not anticipate a major technology change until at least the early 2040's

PTA does however require a transition plan for the point where either the current RAN needs to be replaced or different spectrum would be utilised. Maintaining safe operation of the railway is paramount to PTAs core business and technology change cannot impact on this additional spectrum is anticipated to be necessary to support different generations of equipment and systems. Currently PTA are transitioning from 400MHz to 1800MHz and would require a second frequency range or different bands of same spectrum in order to manage the next major technology change.