AUSTRALASIAN RAILWAY ASSOCIATION

ARA Submission

Exploring the future use of the 1880 – 1920 MHz band

Discussion Paper

19 October 2022 *(amended from 11 February 2022 version)*

ABN 64 217 302 489

The Industry

The Australasian Railway Association (ARA) is a not-for-profit member-based association that represents rail throughout Australia and New Zealand. Our members include rail operators, track owners and managers, manufacturers, construction companies and other firms contributing to the rail sector. We contribute to the development of industry and government policies in an effort to ensure Australia's passenger and freight transport systems are well represented and will continue to provide improved services for Australia's growing population.

This submission has been developed is consultation with ARA member organisations.

Any questions regarding this submission should be directed to Simon Bourke, General Manager – Policy and Government Relations via sbourke@ara.net.au.

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.

General Comments

Future Railway Mobile Communication System

In the 1990s, the European Union (EU) railway sector decided to standardise railway mobile communications systems throughout Europe. This was to address the interoperability challenges of the various disparate systems based on various technologies and frequency bands deployed throughout Europe. The technology chosen was GSM-R, based on commercial GSM technology, but with specific Railway enhancements.

GSM-R proved to be very successful, with over 100,000 km of railway networks in Europe operating over GSM-R. GSM-R has been deployed in countries outside of Europe, including Australia. GSM-R is also used as the data communications bearer for the European Train Control System known as ETCS,

However, GSM-R is based on 2G technology and in 2012 it became apparent the equipment vendors would not be able to guarantee its support beyond 2030. As such, the UIC determined that a

replacement radiocommunication system would be required to address new requirements and functionality such as:

- Conventional voice services;
- Critical video services;
- Other data applications;
- Automatic Train Operation (ATO);
- optimised braking curves;
- reduced track side components;
- enhanced train positioning;
- cybersecurity; and
- GSM-R obsolescence.

This radiocommunication system is known as Future Railway Mobile Communication System (FRMCS) and it will be standardised by 3GPP using reserved EU-wide spectrum in 1900-1910 MHz in addition to the existing 900 MHz band based on the availability of EU-wide spectrum arrangements:

- Commission Implementing Decision (EU) 2021/1730 of 28 September 2021 on the harmonised use of the paired frequency bands 874,4-880,0 MHz and 919,4-925,0 MHz and of the unpaired frequency band 1900-1910 MHz for Railway Mobile Radio[1]

FRMCS is based on 3GPP mission-critical services known as MCX. Where requirements cannot be met by MCX (see 3GPP TR 23.790), additional requirements will be defined in FRMCS system requirements specification (SRS) and functional requirements specification (FRS).

European Implementation Timeframes

Version 5 of the User Requirements Specifications have been released. Use case specifications were released in 2020. 3GPP standardisation of FRMCS functionality has commenced through releases 16 and 17. Full FRMCS implementation is expected in 3GPP release 18. FRMCS SRS and FRS activities have commenced, with initial releases expected in 2022.

FRMCs trials are expected to commence in 2023/2024.

The International Union of Railways (UIC) expects railway operators and manufacturers to be ready to begin deployments from 2025.

Spectrum

In Europe, 4 MHz of 900 MHz FDD spectrum was initially allocated to Railway Authorities for GSM-R deployment.

1 Commission Implementing Decision (EU) 2021/1730, https://op.europa.eu/en/publication-detail/-/publication/aa8ab02f-2187-11ec-bd8e-01aa75ed71a1/

To cater for new requirements, functionalities and migration from GSM-R to FRMCS, the EU has secured an additional 1.6 MHz of 900 MHz FDD spectrum, along with 10MHz of 1900 TDD spectrum, providing a total of 5.6 MHz of 900 MHz FDD and 10 MHz of 1900 MHz TDD Spectrum.

Australian Railways

In Australia, 900 MHz spectrum is unavailable due to differences in frequency band allocations to Europe and existing use by Mobile Network Operators. However, Australian Railway operators of passenger rail networks in capital cities were able to secure 15 MHz of 1800 MHz spectrum for rail safety systems use.

Compared to Europe, the Australian rail industry market is quite small. This has led to some challenges, namely limited equipment availability, equipment obsolescence and limited choice of vendors. In addition, the spectrum license boundaries in some cities have not matched the rail geographic boundaries, preventing the implementation of 1800 MHz based rail safety systems outside the spectrum licensed areas.

ACMA's review of the 1900 MHz band provides Australian transport authorities a timely opportunity to harmonise spectrum with Europe, providing greater choice of equipment, increased geographic footprint and alignment of rail safety systems standards and specifications.

Timeframes

Australian transport jurisdictions have different road-maps for current GSM-R, MCX, and FRMCS, making it difficult to indicate deployment timeframes of FRMCS. However, since MCX equipment is available now, and FRMCS equipment are expected circa 2025, then access certainty to adequate 1900 spectrum will permit transport authorities to commence strategic network planning activities.

Spectrum license type

Railway use of MCX and FRMCS will require dedicated spectrum to manage interference in metropolitan areas as it will be used to provide operations-critical radiocommunication services for purposes of rail safety, operations, and control.

In addition, sufficient spectrum bandwidth will support essential future railway operation requirements and applications such as live streaming CCTV and critical video services.

Some additional apparatus licenses will be required to extend coverage beyond traditional metropolitan spectrum-licensed areas or to be used in conjunction with localised trackside communications applications.

Spectrum license areas

Due to extents of some transport networks, the ability to deploy coverage beyond current metropolitan spectrum license boundaries is required.

For example, in Queensland current geographic boundaries for the 1800 MHz spectrum licenses stop between Beerwah and Landsborough, approximately 70 km short of Gympie, which is the northern most boundary of the current passenger rail network.

In NSW metropolitan area, the current geographic boundaries at the southern electrified rail network area end at Kiama and there is a preference to extend the boundary from Kiama to Bomaderry to cover the entire NSW passenger rail network.

Spectrum license conditions

To maximise spectrum utilisation throughout metropolitan areas, spectrum use should be permitted for State or Territory transport authorities including trains, metros, trams, light-rail, bus road services, and level crossing and intersection management as per *Telecommunications Act 1997* Section 47 (3) and Section 92 (3):

> *47 Exemption—transport authorities*
>
> *(3) Section 42 does not apply to a network unit if the sole use of the unit is use by a State or Territory transport authority to carry communications necessary or desirable for the workings of any or all of the following services:*
>
> *(a) train services of a kind provided by the authority;*
>
> *(b) bus or other road services of a kind provided by the authority;*
>
> *(c) tram services of a kind provided by the authority.*
>
> *(4) Section 42 does not apply to a network unit if the sole use of the unit is use by a rail corporation to carry communications necessary or desirable for the workings of train services.*
>
> *92 Exemption from definition—transport authorities*
>
> *(3) Subsections 87(1) and (2) do not apply to a carriage service if the sole or principal use of the unit is use by a State or Territory transport authority to carry communications necessary or desirable for the workings of the following services:*
>
> *(a) train services of a kind provided by the authority;*
>
> *(b) bus or other road services of a kind provided by the authority;*
>
> *(c) tram services of a kind provided by the authority.*
>
> *(4) Subsections 87(1) and (2) do not apply to a carriage service if the sole or principal use of the carriage service is use by a rail corporation to carry communications necessary or desirable for the workings of train services.*
>
> *(5) In this section:*
>
> *rail corporation means a body corporate that manages or operates either or both of the following:*

(a) rail transport services;

(b) rail transport infrastructure.

Issues for Comment

The following information is provided by the ARA to address the issues for comment provided in the Discussion Paper.

What is the interest in the use of new technologies to provide a service?

Globally, transport services are adopting radiocommunication-based systems to provide mission-critical safety, operations and control of fleet and infrastructure.

For example, rail train control systems are migrating from track-side systems, based on track occupancy, to train movement authorities based on current train location, route set, and braking distance to the train ahead.

These movement authorities permit on-board systems to monitor progress against a specific movement authority and – depending on level of automation – to control train acceleration and braking. Movement authorities are digitally signed and delivered to on-board systems via radiocommunication networks using standards such as European Train Control System (ETCS) or Communications-Based Train Control (CBTC).

Both systems can utilise dedicated spectrum as is done in Australia, Europe, China, Israel, and the United Kingdom (UK). For ETCS, the EU has dedicated 10 MHz of 1900 MHz spectrum for FRMCS use in addition to dedicated GSM-R spectrum in 900 MHz band (UK is open to considering this in a future review of 2100 band).

In Australia, access to 900 MHz spectrum was not possible due to different band-plans, and 1800 MHz band spectrum was licensed instead. Due to being a non-standard GSM-R band, custom mobile radios and base stations are required to support operation of GSM-R or FRMCS in 1800 MHz band.

The EU's decision to allocate 1900 MHz band spectrum, and possible availability of 1900 MHz band spectrum in metropolitan areas, means that Australian transport authorities have an ideal opportunity to source standard equipment for rail operation specifically, and transport in general.

a. How much spectrum is required to provide the service?

FRMCS/MCX requires 10 MHz at 1900 MHz band spectrum based on EU/UIC/ECC assessments due to EU's spectrum limitation, however access to 20 MHz of spectrum would address expected cell capacity issues for critical video and other operational critical high bandwidth data applications in CBD locations. This has been demonstrated by some vendor trials conducted in Europe:

- Harmonised use of the paired frequency bands 874.4-880.0 MHz and 919.4-925.0 MHz and of the unpaired frequency band 1900-1910 MHz for Railway Mobile Radio (RMR)[2]
- Assessment of the spectrum needs for future railway communications[3]

The UIC has compiled user requirement specifications (URS) and use-cases for development of FRMCS within 3GPP standards to ensure future 3GPP development will support FRMCS requirements.

The ARA's view is that UIC URS and use-cases for FRMCS would set minimum spectrum requirements for Australian rail transport operators and that Australian use-cases would drive the spectrum requirements:

- Future Railway Mobile Communication System User Requirements Specification[4]
- Future Railway Mobile Communication System Use cases [5]

Due to lower BW and spectral efficiency of TDD v FDD, MCX and FRMCS and future 1900 MHz use will be limited by access to only 10 MHz of spectrum. Services such as 'FRMCS critical video' are unlikely to be possible within a 30 km radius of major city CBDs due to density of transport services. To address this, additional spectrum in 1910-1920 MHz – subject to unwanted emissions into 1920-1980 UL – would be useful to support FRMCS critical video services.

Most metropolitan railway operators in Australia presently have access to 15 MHz of 1800 MHz FDD Spectrum including 10 MHz of FDD spectrum dedicated to rail safety, operations, and control. To implement a 'walking strategy' of dual networks (described below), ideally two spectrum blocks providing similar capacity is required. To achieve this, access to 20 MHz spectrum in 1900 MHz band is expected to provide similar cell capacity to that of a 10 MHz FDD cell.

b. What interservice considerations need to be undertaken for the service to be deployed?

The EU Least Restrictive Technical Conditions LRTC permit 65 dBm/10 Mhz EIRP. Assuming a net antenna gain of 15 dBi, this is 47 dBm/5 MHz TRP.[6]

A recent 1800 MHz band Spectrum License Technical Framework (SLTF) review permits 50 dBm/ 5 MHz TRP in metropolitan areas and cab-radio TX power of 31 dBm. Cab-radio TX power was based on minimum TX power that ECC considered necessary for FRMCS operation in 1900 MHz band.

Adjacent bands

1800 SLTF lifted restrictions on upper 2.5 MHz of 1800 band to permit wideband transmitters, noting that most DECT systems are indoors and DECT is able to channel-hop to avoid interferers.

2 ECC Decision 20(02), https://docdb.cept.org/download/74859191-cc44/ECC%20Decision%20(20)02.pdf
3 ECC Report 294, https://docdb.cept.org/download/eeb80a06-ec8f/ECC%20Report%20294.pdf
4 FRMCS URS. https://uic.org/IMG/pdf/frmcs_user_requirements_specification-fu_7100-v5.0.0.pdf
5 FRMCS use-cases. https://uic.org/IMG/pdf/frmcs_use_cases-mg_7900-v2.0.0.pdf
6 ECC Decision 20(02), https://docdb.cept.org/download/74859191-cc44/ECC%20Decision%20(20)02.pdf

1900-1910 MHz is also adjacent to DECT band and, using similar logic, no transmitter restrictions should be necessary to protect DECT users.

For 1900/2100 3GPP band 1 uplink mobile services from 1920-1980 MHz, ECC Least Restrictive Technical Conditions limits out-of-band emissions to –43 dBm/5 MHz.

Co-existence of FRMCS and adjacent bands has been studied by ECC in development of EU mandate on FRMCS:

- Co-existence between Future Railway Mobile Communication System (FRMCS) in the frequency range 1900-1920 MHz and other applications in adjacent bands[7]
- Compatibility between RMR and MFCN in the 900 MHz range, the 1900-1920 MHz band and the 2290-2300 MHz band [8]

FRMCS/MCX may require guard bands to protect DECT 1880-1900 and 1900/2100 band 1 uplink mobile services from 1920-1980 MHz

c. What are the deployment scenarios for the service?

As with public mobile network operators, transport operators need to deploy parallel networks that provide two main purposes:

1. Technology migration; and
2. Redundancy.

Initially a single, but highly reliable network is deployed, but as technology and standards improve, support for older equipment cannot be provided indefinitely. This obsolescence problem requires a staged or 'walking' strategy consisting of at least two networks that are alternately upgraded.

Each network requires spectrum to support design, implementation, and operation. In Australia, access to GSM-R spectrum in 900 MHz band is not possible, so initial networks are making use of 1800 MHz band spectrum. To date, NSW and Victoria have deployed GSM-R; Queensland Rail is deploying GSM-R; and Western Australia is deploying LTE/MCX.

Before GSM-R and LTE/MCX support ends, replacement networks must be deployed to ensure continuity of service. This must be completed while current network is operational with full support of all equipment suppliers. To avoid redesign of current network, sufficient spectrum is required to operate at least two parallel networks and - if this is suitably timed - benefits of parallel network operation can be realised.

When the EU reserved 1900 MHz spectrum for rail, a timely opportunity was created for Australian rail industry to seek access to 1900 MHz spectrum. This spectrum would be used to plan for FRMCS deployment - independent of current operating networks - and permit transport operators to take advantage of standardised product and services.

7 ECC Report 314, https://docdb.cept.org/download/64824326-aa9c/ECC%20Report%20314.pdf
8 ECC Report 318, https://docdb.cept.org/download/3e89c08b-5982/ECC%20Report%20318.pdf

An additional benefit is that 1800 MHz and 1900 MHz are expected to have similar propagation characteristics that will generally permit re-use of sites and infrastructure designed for 1800 MHz band.

Migration issues facing European rail operators has been studied by ECC in development of EC mandate on FRMCS:

- Assessment of the spectrum needs for future railway communications[9]

Are there any applicable coexistence scenarios not identified? Are there any scenarios that are unlikely to be practically achievable (and hence the associated planning scenario should be discounted), or are there any that are readily achieved?

Available bandwidth in 1900 MHz band is limited by DECT (1880-1900 MHz) and 3GPP band 1 user equipment (1920-1960 MHz).

Other uses for 1900-1920 MHz have been proposed such as DECT 2020, and Multefire – all current uses involve networks or systems considered to be 5G:

- DECT-2020 New Radio (NR); Part 1: Overview
- ETSI TS 103 636[10]
- About MulteFire Release 1.1 Specification[11]

For FRMCS, only 1900-1910 MHz spectrum can currently provide harmonisation with the EU standards which permits Australian transport operators to utilise standard product.

Due to the EU allocation of 1900-1910 MHz, DECT 2020, Multefire, and any others will necessarily need to make use of either DECT 1880-1900 MHz, or some other spectrum: DECT 2020 and Multefire are able to utilise other spectrum, including class licensed spectrum, which means these systems are not disadvantaged by licensing of 1900-1920 MHz to transport operators.

The EU allocation and commitment to FRMCS and ETCS means that 1900-1910 MHz product will be developed and supported for long periods to ensure rail operations in Europe. This long-term support commitment is demonstrated by multiple supplier support of GSM-R to at least 2030 and provides certainty to Australian operators.

MNO's interest in 1900 MHz is unlikely due to economic viability. While there has been a trend of increasing numbers of devices being available in the 1880–1920 MHz band, majority of them are mobile devices and still there is a lack of base station equipment available in this band.

Co-existence of FRMCS and adjacent bands has been studied by ECC in development of EC mandate on FRMCS:

[9] ECC Report 294, https://docdb.cept.org/download/eeb80a06-ec8f/ECC%20Report%20294.pdf
[10] https://www.etsi.org/deliver/etsi_TS/103600_103699/10363601/01.02.01_60/ts_10363601v010201p.pdf
[11] https://www.mfa-tech.org/technology/specifications-2/

- Co-existence between Future Railway Mobile Communication System (FRMCS) in the frequency range 1900-1920 MHz and other applications in adjacent bands[12]
- Compatibility between RMR and MFCN in the 900 MHz range, the 1900-1920 MHz band and the 2290-2300 MHz band [13]
- Assessment of the spectrum needs for future railway communications[14]

What are possible planning scenarios and industry views on the overall future use of the 1.9 GHz band and its services:

a. How much spectrum is required (distinguishing between the minimum viable and desirable) to provide the service?

To utilise 1900-1920 spectrum, allocation must be 5, 10, 15, or 20 MHz for n39 band.

The EU have allocated 10 MHz of spectrum for FRMCS in addition to the current 900 MHz due to their spectrum limitation. This spectrum will be assumed to be available for all FRMCS equipment and critical video services only, and therefore, to make use of 1900 spectrum, a total of 20 MHz minimum is required in Australia from 1900-1920 MHz to support FRMCS critical video services and future high bandwidth applications such as real-time CCTV between the train and the ground.

The ARA understands that there may be potential interference issues with 1920-1960 MHz UL that may limit general use of this spectrum - especially near 1920 MHz band boundary.

In this case, 1910-1920 MHz could also be allocated to transport operators to permit increased data capacity for network monitoring and reporting and FRMCS critical video in, say 1910-1915 and using 1915-1920 for lower power in-fill applications, thus providing protection of 1900/2100 UL.

The ARA cannot see an end-date for use of 1900 MHz spectrum for rail safety, operations, and control for metropolitan transport networks: once track-side signalling is decommissioned, radiocommunication based train control will be a required and necessary system for safe operation of transport networks.[15]

b. Is there a clear geographical delineation – for example, metropolitan or regional – for the service?

ARA members would prefer more optimal geographic areas that suit current or future network areas. Generally, current metropolitan spectrum license areas are adequate, but access to regional spectrum would be required in some locations to provide complete transport corridor coverage.

Freight and intercity transport will benefit from common equipment and standardised spectrum to limit number of radiocommunication devices and protocols for interoperability. For example, previous efforts have rationalised and harmonised use of 400 MHz spectrum rail safety, operations,

12 ECC Report 314, https://docdb.cept.org/download/64824326-aa9c/ECC%20Report%20314.pdf
13 ECC Report 318, https://docdb.cept.org/download/3e89c08b-5982/ECC%20Report%20318.pdf
14 ECC Report 294, https://docdb.cept.org/download/eeb80a06-ec8f/ECC%20Report%20294.pdf
15 Cept report 74 - FRMCS Spectrum needs and feasibility, https://docdb.cept.org/download/133

and control with RALI MS22 and Frequency Assignment Practice guideline No. 7. This plan and assignment guideline has standardised channels nationally, and established a process to efficiently use spectrum by rail and, importantly, non-rail entities.

In Queensland, current geographic boundaries for the 1800 MHz spectrum licenses stop between Beerwah and Landsborough - approximately 70 km short of Gympie, which is the northern most boundary of the current passenger rail network. This would allow the implementation of ETCS for future public transport systems to Maroochydore.

Access to 1900 Spectrum in regional Queensland would allow the implementation of ETCS to replace legacy train protection systems used on the regional freight and long-distance passenger rail networks.

In Victoria, current spectrum license limits are generally seen as adequate for electrified rail operations within Greater Melbourne. Future rail services may require similar coverage beyond the current 1800 MHz geographical boundaries for which an increase in the boundary will be necessary or access to a suitable alternative spectrum, i.e, 1900 MHz.

In NSW, current spectrum license limits are generally seen as adequate for current operations. Investigations into faster rail transport require coverage beyond current spectrum boundaries. It is likely that access to 1900 MHz spectrum in non-metropolitan areas will be required. In addition, current geographical boundaries at the southern area stops at Kiama. For the future rail services, the boundary will need to extend to Bomaderry.

In Western Australia, current geographical boundaries for the 1800 MHz spectrum licences are adequate for electrified passenger rail operations in the Perth and Peel regions for the current and foreseeable future. Future rail services may require similar coverage beyond the current 1800 MHz geographical boundaries for which an increase in the boundary will be necessary or access to a suitable alternative spectrum, ie 1900 MHz.

In South Australia, current geographic boundaries for the 1800 MHz spectrum licenses stop short of the complete network. The Adelaide Metropolitan Rail network (AMPRN) operates from Adelaide CBD to Seaford (south) and Gawler (north), and to Outer Harbor (west) and Belair in the Adelaide hills (east). The north / south corridor is likely to be extended in the distant future.

c. Is there or will there be equipment readily available for the service?

Due to the EU allocation of 1900-1910 MHz spectrum dedicated for FRMCS use, manufacturers servicing this market will be providing cab radios and data-only radios for ERTMS/ETCS operation in 1900 MHz band:

> 'This ECC Decision addresses the designation of the paired frequency bands 874.4-880.0 MHz and 919.4- 925.0 MHz and of the unpaired frequency band 1900-1910 MHz to be used for Railway Mobile Radio (RMR) on a CEPT wide basis. RMR supports railway operations and especially those in accordance with the Directive 2016/797/EU of the European Parliament and of the Council on the interoperability of the rail system [1] and the Commission Regulation 2016/919/EU on the technical specification for interoperability relating to the

'control-command and signalling' subsystems of the rail system [2]. RMR encompasses GSM-R and its successor(s), including the Future Railway Mobile Communication System (FRMCS).'[16]

To use this equipment in Australia, importers will need to demonstrate that they comply with Australian rules; make Declaration of Conformity; and label equipment. Due to nature of FRMCS equipment based on 3GPP standards, this process is not expected to introduce any impediment to supply by multiple manufacturers.

16 EU decision is ECC Decision 20(20), https://docdb.cept.org/download/74859191-cc44/ECC%20Decision%20(20)02.pdf