

Sydney Trains Submission

Expiring spectrum licences: stage 2
Information gathering, and views on uses of
frequency bands and alternative licence
conditions

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Sydney Trains

Sydney Trains is the operator of rail services across the metropolitan Sydney area, bounded by Berowra, Emu Plains, Macarthur, and Waterfall. Sydney Trains provides passenger rail services in Greater Sydney, operates, and maintains the heavy rail network for customers and provides network control for freight.

The network is a hybrid urban-suburban rail system with a central underground core that covers 919 km of electrified track and serves 168 stations. Sydney Trains also operates the Rail Operations Centre and is responsible for the maintenance of assets including tracks, trains, signals, overhead wiring, stations, and facilities. Sydney Trains also maintains trains and a large proportion of the infrastructure used by NSW TrainLink.

Sydney Trains currently holds spectrum licences in the 1800MHz spectrum band (licence no: 9460463 and 9460464). This spectrum is exclusively used for operating the Digital Train Radio System (DTRS), a private GSM-based network to support safe and efficient delivery of rail services in NSW. We appreciate the Australian Communications and Media Authority for the opportunity to make this submission. For any questions regarding this submission should be directed to [REDACTED]

Sydney Trains View on Expiring Spectrum Licence

Sydney Trains appreciates the opportunity to submit comments on "Expiring Spectrum Licenses: Stage 2." As an incumbent spectrum licensee under the ESL framework, Sydney Trains would like to provide detailed information on its current and future spectrum usage, highlighting how it serves and promotes public interests.

Sydney Trains requests that ACMA considers the following needs of Sydney Trains:

- **Renewal of all expiring 1800MHz licences used by Sydney Trains;**
- **Amendment of license:** For licence that currently does not have “rail safety and control communications” condition to include the condition that it be used only for “rail safety and control communications”;
- **Permanent spectrum allocation:** Sydney Trains seek a permanent spectrum allocation for “rail safety and control communications”, similar to the European Union. Alternatively, Sydney Trains proposes a 20-year licence term. This will provide certainty and promote NSW state government’s investment in the latest globally supported technology for rail, specifically the Future Rail Mobile Communications System (FRMCS). FRMCS incorporates the latest innovations from 3rd Generation Partnership Project (3GPP) standards and application of communications-based train control systems, and
- **Public Interest Pricing:** As a NSW government entity, Sydney Trains advocates for public interest pricing for spectrum access charges, ensuring non-commercial use of the spectrum for rail services is economically viable.

Context

Sydney Trains’ Digital Train Radio System (DTRS) enables secure two-way voice and data communications between train crews and track workers to network control personnel including signallers, train controllers, mechanical and operations supervisor controllers across the Sydney Trains network extending from Newcastle in the North to Lithgow in the West and Kiama in the South. The DTRS is a Global System for Mobile – Railway (GSM-R) based private network operating in the 1800MHz spectrum band and is used to support 259 million passenger journeys annually and ensures the safe movement of approximately 29 million tonnes of freight per annum across Sydney Trains’ rail corridor.

One of DTRS’ main functions is to support Rail Emergency calls (REC). In addition, the DTRS will carry train movement authorities and signalling information for the European

Train Control System – Level 2 (ETCS-L2). ETCS-Level 2 is a communications-based train control system and utilises the DTRS network to communicate with onboard systems for safe movement of trains. Deployment of the ETCS-L2 is currently underway in NSW.

Future Railway Mobile Communication System (FRMCS) is the successor to GSM-R. FRMCS standards are currently being developed by the International Union of Railways (UIC). The European Commission (EC) has agreed to allocate harmonised spectrum across Europe for railway mobile radio by assigning spectrum in both the 900MHz (the existing GSM-R band in Europe) and the 1900MHz band. In Australia, the 900MHz spectrum band was not available for rail use and through spectrum consolidation and harmonisation, a portion of the 1800MHz band was made available by the ACMA to rail operators across Australia, including Sydney Trains.

Information requested from incumbent licensees

Public interest criterion 1: facilitates efficiency

How does your current and planned use of the spectrum facilitate efficiency?

Sydney Trains 1800MHz spectrum license boundary extends from Newcastle in the north, to Kiama in the south and Lithgow in the west. The 1800MHz spectrum is exclusively used to operate the DTRS network that covers the entire electrified rail network within the license boundary (Addendum A).

Current Use

Currently, this spectrum is used to provide safety-critical and safety-related voice communications between train crews, and track workers to network control personnel such as signallers, train controllers, mechanical and operations supervisor controllers. Data communication over the spectrum is utilised for retrieving diagnostic log files from onboard equipment and for carrying out software upgrades to onboard equipment.

The ability to provide a modern and single radio communication platform across various operational crews improves rail safety and day-to-day operations, while aligning with the recommendations from the 2003 Waterfall¹ Incident. Furthermore, the ability to remotely perform diagnostic and routine maintenance activities facilitates operational efficiency for Sydney Trains.

¹ The Waterfall rail accident was a train accident that occurred on 31 January 2003 near Waterfall, New South Wales, Australia.

Planned Use

Currently a project is in progress to implement the ETCS-L2 signalling system which will utilise the DTRS network to convey train movement authority and signalling information across the 1800MHz spectrum. This deployment enhances the capacity for train movements within existing rail infrastructure, thereby enhancing overall efficiency of train services in NSW.

In the future, Sydney Trains intends to leverage the 1800MHz spectrum band for FRMCS, enabling a broad range of use cases that are supported by the modern technology and standards. Presently several systems exist within Sydney Trains to provide numerous services and applications to support train operation. However, the inherent inefficiency of GSM-based technology in spectrum utilisation coupled with its limited bandwidth capability means that these use-cases were not able to be accommodated by the current DTRS network. Transitioning to a 5G-based FRMCS network will significantly improve spectrum efficiency by consolidating services, including both low and high bandwidth applications onto a single network. This consolidation reduces the reliance on disparate system, thereby streamlining rail operations for greater efficiency.

> *evolving use of the spectrum over the current and potential future licence term*

The current Sydney Trains GSM-based network will commence its transition into a 5G-based network circa 2028. While the majority of services currently provided by the existing GSM-R network can be migrated during the gradual roll out of the 5G network, the ETCS-L2 application will need to remain on the GSM-R network until roll out of the 5G network is fully completed. Consequently, during this transition period, it is anticipated that both the GSM-R and 5G FRMCS network will co-exist, utilising the same 1800MHz spectrum to support all services. Moreover, Sydney Trains foresees the need for additional spectrum in the 1900MHz band to support coexistence of both networks, as indicated by the technical study conducted thus far.

At present, 5MHz of Sydney Trains' spectrum (Licence No. 9460463) is reserved as a guard band under Sydney Trains' interference management strategy where out-of-band interference has been experienced from high-powered wide-band commercial carrier in adjacent band (Addendum B and Addendum C). However, during the GSM-R-to-FRMCS transition period and following completion of the transition, this spectrum is expected to be fully utilised, optimising the utilisation across the whole of Sydney Trains' licensed 1800MHz spectrum band.

- > *current and planned services provided, including the technology and bands used, geographic availability, and whether providing coverage or capacity/infill*

The ETCS-L2 signalling system, currently being deployed, will replace traditional train control signalling system and increase the number of train services in the network. ETCS-L2 relies on the DTRS to communicate with onboard systems for safe movement of trains. An analysis has been undertaken to determine the additional DTRS infill sites needed to meet end to end performance requirements as specified in the standard, UNISIG² GSM-R Bearer Services Requirements, Subset 093, and to support the increased capacity due to the expected increase in the number of trains services. To address frequency reuse constraints, the top 2.5MHz band of the spectrum will be utilised for infill sites.

In addition to current use cases supported by the DTRS, the FRMCS will enable advanced applications such as automatic train operation (ATO), remote train condition monitoring, remote infrastructure monitoring, and high-bandwidth applications such as critical real time video for passenger and staff safety and augmented reality data communication. FRMCS will also serve as the foundation for further innovations for the rail networks including application like ATO that will help reduce overall operating costs and optimising the capacity of the rail network. FRMCS will enable digitalisation, automation, and future readiness of rail services.

Availability of sufficient capacity is crucial for implementing these new services, thus requiring adequate spectrum bandwidth. A desktop study by Sydney Trains indicated that both 10MHz TDD (Time Division Duplex) spectrum in 1900MHz and 15MHz FDD (Frequency Division Duplex) spectrum in 1800MHz will be necessary to implement these applications without the need for excessive infill sites when reusing current GSM-R sites for FRMCS (Addendum D).

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

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

² UNISIG is a Committee of UNIFE (the European Rail Industry Association)

> *anticipated trading or acquisition of spectrum through the secondary market*

Sydney Trains do not anticipate any trading or acquisition of spectrum through secondary market.

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

Prior to 2021, the top 2.5MHz of Sydney Trains' spectrum band was subject to a power limitation lower than that of the remaining band. This limitation posed a challenge in fully utilising that portion of the spectrum band for the DTRS network. In collaboration with the Australasian Railway Association (ARA), the ACMA lifted the power limitation and Sydney Trains has since fully utilised this portion of the band as part of the frequency arrangement for its existing DTRS network.

Sydney Trains is not currently aware of any planning, licensing, nor technical arrangements that prevent Sydney Trains from efficient use of its spectrum.

Public interest criterion 2: promotes investment and innovation

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

Sydney Trains expects that its planned use of the spectrum for its future 5G FRMCS network will allow innovative uses cases beyond existing applications. With the proliferation of Internet-of-Things (IoT) technology and the ongoing digitalisation of railway operation, Sydney Trains aims to provide a more 'connected' end-end customer journey experience. Moreover, enabling infrastructure that provides low-latency and high-bandwidth connectivity throughout its rail corridor will allow Sydney Trains to deploy smart sensors across the network enabling a more predictive maintenance approach to its assets.

It is essential to recognise that spectrum strategy is intricately intertwined with investments aimed at modernising the DTRS and expanding its services. Sydney Trains emphasises that State government investment hinges on the assurance of long-term spectrum tenure.

Uncertainty around 1800MHz spectrum availability beyond 2028 coupled with unavailability of commercial network equipment that supports 5G networks in the 1900MHz band are delaying these investments. With expected asset life of 15 years, return on investment for a 5G network will be low, rendering it economically unattractive

should spectrum tenure is not guaranteed for a similar amount of period. Hence, securing a spectrum tenure of 15–20 years is imperative to facilitate investment in this critical infrastructure.

> *current and planned investment in equipment and infrastructure to make use of the spectrum, including, but not limited to, base stations and underlying network infrastructure*

The deployment of ETCS-L2 is dependent on the ability of the DTRS to meet stringent performance requirements outlined in the ETCS standards. As the initial deployment progresses, an analysis of spectrum requirements to support ETCS performance and capacity is underway.

Concurrently, Sydney Trains is undertaking several sustainment projects aimed at improving the maintainability of its aging DTRS, which faces obsolescence concerns. The continuity of vendor support for the DTRS remains uncertain beyond 2026. In line with the UIC roadmap, FRMCS standards are anticipated to be available in Q4 2028, with additional time required for the development of fully compliant commercial products.

In light of these considerations, Sydney Trains is actively exploring the adoption of 5G mobile technology with MCX (Mission Critical Services) capability as the interim solution before transitioning into a fully FRMCS-compliant network.

> *current and planned new business cases involving use of the spectrum*

Sydney Trains is actively pursuing the business case development to replace its aging GSM-based DTRS network. It should be economically feasible for Sydney Trains to deploy the FRMCS network. Less spectrum bandwidth availability will result in more base station sites. A desktop study carried out by Sydney Trains showed that both 10MHz in 1900MHz and 15MHz in 1800MHz will be required to implement FRMCS supported use cases without having to build many infill sites if existing GSM-R sites are reused (Addendum D).

Public interest criterion 3: enhances competition

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

Sydney Trains relies on a communication network utilising radio spectrum, which is heavily influenced by international standard and the availability of commercial equipment from network vendors. Mobile communication networks globally operate within the 1800MHz spectrum band, ensuring a wide range of equipment vendors capable of supporting this frequency band. Adopting the 1800MHz band would obviate the necessity

for bespoke or customised products, streamlining the procurement process. This move would position Australia as a competitive marketplace for rail network equipment, enticing equipment vendors to invest and innovate within the country's rail sector.

By leveraging spectrum and wireless technology to transmit train movement authority and signalling information, Sydney Trains aims to offer a competitive mode of transport to the people of Sydney and NSW. Furthermore, rail transport is widely recognised as a sustainable and environmentally friendly option, playing a crucial role in reducing the overall carbon footprint.

Public interest criterion 4: balances public benefits and impacts

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

Sydney Trains' ability to provide safe and reliable rail transportation services is vital for driving economic growth in NSW.

Sydney Trains' use of the 1800MHz spectrum in its DTRS network ensures critical voice communication and emergency call capabilities between train crews and network control personnel, facilitating the safe operation of train services. This capability enables Sydney Trains to fulfil its legal responsibilities under the Rail Safety National Law while delivering public benefit to approximately 259 million passenger journeys annually on the Sydney Trains network. Additionally, the DTRS is also key requirement in ensuring safe passage of freight trains across Sydney Trains' corridor. With around 29 million tonnes of freight transported annually on the Sydney Trains' network and a projected 12% annual growth, this system is a key enabler of economic growth in NSW.

The 1800MHz spectrum is integral to the rollout of ETCS-L2, which replaces traditional train control signalling systems. This upgrade will enhance the number of train services on the network, benefiting the broader public. The DTRS is a critical component of the ETCS-L2 signalling system, ensuring the safe and more efficient movement of trains.

As FRMCS deployment begins, it will necessitate upgrading in-cab radios to support FRMCS, including the installation and/or replacement of antennas and user equipment. This complex and costly process will require meticulous planning for each fleet. To maintain train services until the FRMCS network is fully operational, Sydney Trains must keep the current DTRS network functional, necessitating separate frequency bandwidths for GSM-R and FRMCS. Therefore, retaining the 1800MHz spectrum beyond 2028 is

essential, as the planning and deployment of FRMCS is expected to take approximately 8 to 10 years.

Sydney Trains is of the view that only a separate and dedicated network utilising distinct and dedicated spectrum can meet the stringent reliability, availability, safety, and security requirements for rail operation's radio-communications services.

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?

Although Sydney Trains 1800 MHz spectrum licence is confined to metropolitan areas, this spectrum is crucial for rail safety and control communications for both passenger and freight transport across the entire Sydney Trains network, extending into regional and rural areas of NSW.

Sydney Trains plays a critical role in driving economic growth and improving quality of life, keeping freight moving productively and sustainably for the people of NSW and Australia.

Alternative uses for spectrum

Out of Sydney Trains' current 15MHz spectrum license in the 1800MHz band, 10MHz is designated specifically for rail safety and control communications. The remaining 5MHz, however, lacks this designation. Sydney Trains proposes that the 5MHz band be used for rail safety and control communication purposes only.

- > *why an alternative use for the relevant spectrum would promote the long-term public interest*

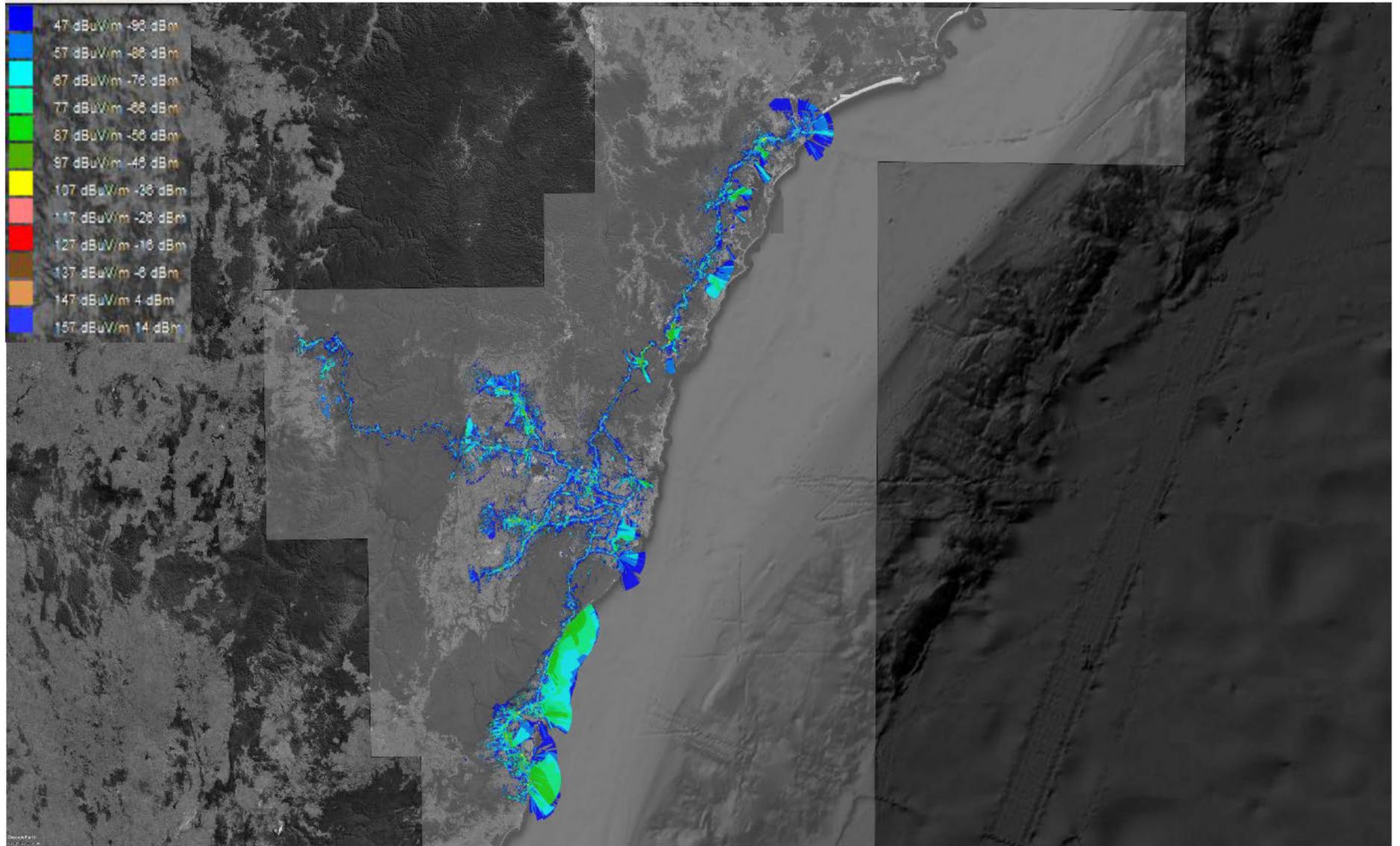
Designating the entire 15MHz bandwidth in the 1800MHz spectrum band for rail safety and control communication purposes will ensure that these bands are used to support safe and efficient rail operation which in turns reduces the cost in providing public service to the people of Sydney and NSW.

- > *high-level changes to licence conditions and technical frameworks that would be required to implement the alternative use.*

Sydney Trains recommends that the same license condition be applied to the entire 15MHz spectrum band, ensuring uniformity and support for rail safety and control communications across the full spectrum. This will also support the intent to ensure that spectrum is not commercialised, nor it being used to compete with commercial mobile network operators.

Addendum A – DTRS Coverage Map

The image (below) overlays simulated DTRS coverage with Sydney Trains 1800MHz spectrum licence geographic boundary.



Addendum B – Revesby Interference Issue

Revesby train station is situated 21 km down from Central station on the T8 Airport and South line. In reference to the nearest DTRS sites, Revesby station is located between BTS sites 070 Padstow and 071 Panania. Revesby Station is located approximately 1.5km down from 070 Padstow BTS and 2km up from 071 Panania BTS. 070 Padstow is the dominant serving cell across Revesby Station platforms.

Fault ticket was generated on 28th June 2022 based on a reported incident, where three separate trains were unreachable through the DTRS train radio when stopped at Revesby Platform 3. Field technicians visited the station platforms and were able to establish calls to the Revesby panel via DTRS GSM-R handsets on multiple occasions. The handsets reported a signal level of -77dB and RxQual of 4.

On the country end of Revesby station platforms, nearby mobile carrier systems could be identified within proximity [80-150m] and were of interest for the troubleshooting of potential causes of the issue given previous similar issues affecting DTRS receive quality being found and resolved at Mortdale (2019) and Redfern (2021).

DTRS testing on Revesby Station platform identified the issue was due to the combination of weak DTRS signal and proximity to mobile operator transmitters directed towards the station platform. Frequency at 070-Padstow was configured to achieve maximum spectrum separation from mobile operator networks. This did not fix the issue. Therefore, a new DTRS was built near Revesby station to increase DTRS signal strength. After this, no call failures were observed.

Addendum C – Liverpool Interference Issue

During normal service on 8th October 2023, a driver initiated a Radio Emergency Call (REC) from the cab radio. During the call, the Signaller was unable to hear the driver's voice for approximately 60 seconds. Subsequent calls made to the radio did not exhibit the same characteristics. An incident was raised, and analysis was conducted to ascertain the root cause of the poor voice quality noted during the REC.

Initial coverage test calls completed without issue, both point to point and group calls representative of post incident test calls made to the train (driver and guard radios) on the day of the incident. Calls were also conducted with trains on the platform where failures occurred in a similar manner to the failure experienced by the driver during the incident.

Local RF testing under variable conditions showed Mobile Network Operator (MNO) site using beam forming antennas installed ~300m from the platform are impacting cab radio communications when a loaded passenger train is stopped at the platform. This interference was most impactful when the train had passengers onboard and was stopped in proximity to the MNO cell site, and distant from the DTRS serving cell (Liverpool is midway between two DTRS cells).

It was proposed to change frequencies on the serving DTRS cell to improve discrimination between mobile operator spectrum and DTRS channels. After the frequencies were retuned, no call failures were observed.

[REDACTED]

- [REDACTED]

- [REDACTED]

- [REDACTED]

- [REDACTED]

- [REDACTED]

[REDACTED]



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