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PMR and WBB LMP Licensing

A report from DotEcon

Consultant Report

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An Coimisiún um Rialáil Cumarsáide
Commission for Communications Regulation
1 Lárcheantar na nDugaí, Sráid na nGildeanna, BÁC 1, Éire, D01 E4X0.
One Dockland Central, Guild Street, Dublin 1, Ireland, D01 E4X0.
Teil | Tel +353 1 804 9600 Suíomh | Web www.comreg.ie

dot·econ

PMR and WBB LMP Licensing

Prepared for ComReg

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DotEcon Ltd • 1.01 Clerkenwell Workshops • 27-31 Clerkenwell Close • London EC1R 0AT
Phone +44 (0)20 7467 2070 • Email: info@dotecon.com • www.dotecon.com
Registered in England and Wales • No 3783016 • Registered Office as above

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Scope of the report

DotEcon has been commissioned by ComReg to assess and provide recommendations on licensing frameworks for Private Mobile Radio (PMR) and Wireless Broadband Low-Medium Power (WBB LMP) Local Area licensing in Ireland. ComReg has an existing PMR licensing regime in place, currently operating with several distinct licence types. The potential for WBB LMP licensing, on the other hand, follows recent European work to harmonise use of the 3.8-4.2 GHz band for these applications. This band is intended to support private 5G applications, which may have significant economic impact in sectors such as advanced manufacturing and logistics.

The scope of this project covers all components of the existing and proposed licensing frameworks, including:

- review of the relevant regulations (European, international and domestic);
- assessment of use cases and user needs (determining likely future demand for spectrum);
- assessment of factors such as the potential for interference and any scarcity concerns affecting the appropriate design of the licensing framework;
- identification of the most appropriate structure for a licensing regime going forward; and
- assessment of the appropriate level and structure of fees that should apply.

Inputs

Our findings and recommendations are informed by desk research and analysis of historical licensing data (where available). We are grateful to numerous stakeholders who found time to be interviewed and shared their views. In the case of PMR, we also ran an online questionnaire for stakeholders.

The two frameworks should be independent

There is some overlap in use cases for PMR and WBB LMP, but this is limited. Therefore, licences under the two schemes are unlikely to be substitutes and different considerations apply in the design of appropriate licensing frameworks in the two cases:

- PMR licences cater for narrowband operation (with typical channel sizes of 12.5 kHz), whereas far greater bandwidths will be used for WBB LMP in the 3.8 - 4.2 GHz band.
- Most PMR use cases, aside from PMSE, focus on voice and messaging services. Those identified for WBB LMP are more

varied and complex, often needing low latency and protected use of the spectrum. Coordination of users will likely be more complicated for WBB LMP usage, and there is risk of localised congestion in the future.
- PMR usage is well-established with a licensing scheme running for decades. There are pre-existing concerns and a reasonably clear path of likely future usage. In contrast, a WBB LMP licensing framework for the 3.8 – 4.2 GHz band will be entirely new and cater for uncertain and emerging applications.

Structure of the report

The established nature of PMR means that we can make concrete recommendations to ComReg at this point, including on pricing. However, with WBB LMP it is prudent to gather further input from ongoing harmonisation work and stakeholders' responses to ComReg's consultation before formulating detailed recommendations for licensing. Therefore, this document comprises two distinct parts:

- Part 1 reviews and makes recommendations for adjustments to the PMR licensing framework;
- Part 2 sets out key considerations for a new WBB LMP licensing framework and potential options.

Part 1 – PMR licensing

Part 1 starts by describing the current ComReg PMR regime. This features seven distinct licence categories. We identify the varied use cases common under these different licence types.

As the current PMR regime has been introduced in stages going back decades, it is clear the framework needs to be updated. The key finding is that the majority of licence types that fall under the umbrella of PMR can be consolidated into a single, flexible licence type. The exception is PMSE, which due to its different patterns of usage should remain as a separate licence type.

We provide detailed recommendations on a new unified fee structure based on bandwidth, coverage area and whether the licence is exclusive. Scarcity does not appear to be a major concern for this spectrum, so fees are set primarily to cover ComReg's administrative costs. Within this constraint, fees are structured to provide incentives to use the spectrum efficiently to help avoid congestion in the future.

Part 2 – LMP Local Area licensing

Part 2 assesses key considerations and options for WBB LMP licensing in the 3.8-4.2 GHz band. We review the current regulatory landscape and identify and describe likely use cases. We establish key objectives of a new licensing regime, especially in regard to promoting investment certainty for new private 5G

applications. We set out high-level options for licence duration, geographic scope of licences, rollout conditions, application requirements and information for users and fee structure.

Key considerations are the diverse range of potential needs (in terms of bandwidth, coverage area, indoor/outdoor use, power levels, and TDD uplink/downlink patterns) across numerous potential use cases. Whilst demand for this spectrum is initially expected to be limited, there is scope for usage to expand rapidly in the foreseeable future (for example, as equipment with connectivity in this band becomes widespread in certain sectors). Therefore, the licensing framework needs to be robust to the potential for demand for this spectrum to evolve rapidly. Clusters of users (e.g. at campuses and shared industrial sites) could be commonplace, leading to potential for congestion unless appropriate coexistence measures are already in place.

Part 1: Private Mobile Radio

1 Private mobile radio

The Commission for Communications Regulation (ComReg) has engaged DotEcon Ltd (DotEcon) and Axon Consulting (Axon) to assist with its review of the Private Mobile Radio (PMR) licensing framework in Ireland. The study looks at all aspects of the licensing framework, including (but not limited to):

- existing and potential use cases for PMR;
- recent trends and likely future developments in demand for PMR licences in Ireland;
- the need, if any, for making new bands available for PMR licences and/or for adjusting the current set of available bands;
- the structure of licences to be assigned as part of a future licensing regime;
- the technical conditions and guidelines for licensing PMR; and
- an appropriate fee schedule for PMR licences.

During the initial stages of the project, we conducted a series of interviews with various stakeholders and issued a survey to all PMR licensees. Together these collected the views of a broad range of stakeholders using the current suite of PMR licence types.

This document sets out our provisional views and recommendations, based on the feedback received from stakeholders, analysis of ComReg's PMR licence data and desk research. The scope of this report covers:

- the current PMR licensing regime in Ireland;
- use cases for PMR;
- the spectrum available to PMR operators;
- interference issues experienced in this spectrum;
- scope for consolidation of PMR types; and
- fees that should apply to PMR licences going forward.

This report will be published alongside ComReg's consultation documents and we welcome further stakeholder input on our recommendations as part of that consultation process.

2 Current regime

2.1 PMR licensing in Ireland

ComReg currently issues PMR licences in seven categories. These categories are governed by separate guidelines (collectively the 'PMR guidelines'), with varying licence conditions and fees.[1]

The PMR licence categories available are:

- **Business radio** systems that communicate on a one-to-all basis from a fixed control point or mobile terminal.
- **Third party business radio (TPBR)** licences are designed to allow the holder to lease radio equipment and spectrum access to third parties for business radio operations.
- **Mobile radio** (also called **trunked radio**) systems use a pool of channels that can be accessed by multiple users.
- **Community repeater** systems comprise a base station (typically in a remote position on a high site), trigger stations, and mobile stations that allow equipment providers to offer use of the base station. The systems provide two-way communications services to a number of users on a channel-sharing basis.
- **Telemetry** systems transmit automated measurements from remote locations to receiving stations for monitoring and control purposes.
- **Programme making and special events (PMSE)** licences cover the operation of radio equipment at a given location/event, for a specified time not to exceed six months.
- **Paging** systems send one-way coded signals (e.g. a beep or a text message) to a paging receiver owned by a subscriber. Currently, ComReg grants paging *permits* rather than licences, and there are no fees nor expiry dates associated with a paging permit.

Previous national telemetry licences expired in 2024. In advance of this, ComReg undertook a separate review specifically for telemetry to ensure both national and regional telemetry

[1] See https://www.comreg.ie/industry/radio-spectrum/licensing/search-licence-type/business-radio/ for a summary a links to latest versions of the guidelines documents

licences remained available following their expiry and avoid disruption to users. [2] While telemetry licences have previously fallen under the PMR umbrella (in that they are assigned channels in the same VHF and UHF bands, the licences themselves were already distinct from PMR licences in practice), they have now been moved outside of the PMR framework and are beyond the scope of this review. The updated guidelines and licensing framework for telemetry licences are available on the ComReg website.[3]

Nevertheless, we occasionally refer to telemetry licences (including summarising telemetry licence conditions in Annex A because telemetry as a *use case*, distinct from the telemetry *licence type*, has historically made use of other types of PMR licence not just telemetry licences.

Current licences

ComReg's licence data shows that 784 users hold a total of 1,260 active PMR licences (excluding paging permits, where the number of active users is uncertain because they do not expire), with business radio licences being by far the most common licence types.

As shown in Figure 1:

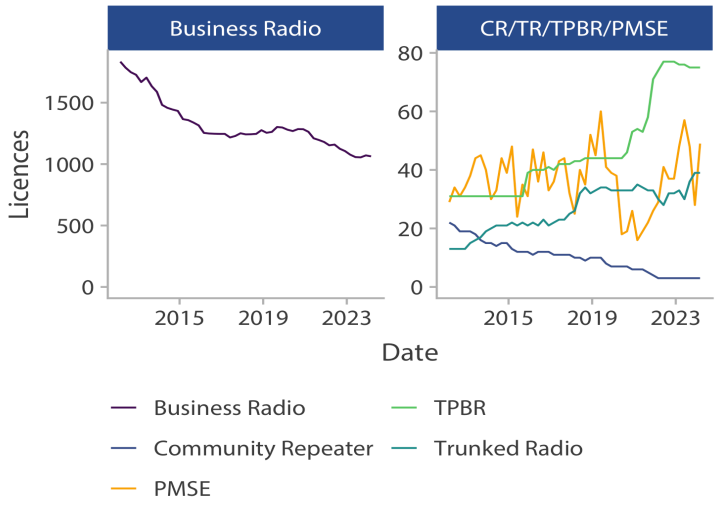
- there has been relatively little change in the number of **business radio** licences since 2016, after a significant fall in the number of licences before that year;
- as expected, **TPBR** licence numbers increase during the application windows for those licences (with the two most recent windows opening in 2015 and 2020) and are relatively constant between windows;
- the number of **trunked** radio licences has risen over time; and
- the number of **community repeaters** has steadily declined.

Being linked to specific, short-term events, the number of PMSE licences is notably more volatile than for other PMR licence types. Unsurprisingly, there was a significant fall during the Covid-19 lockdowns, followed by a recovery, but there is no obvious long-run trend.

[2] On 3 April 2024, ComReg introduced an updated licensing framework for telemetry systems in the VHF and UHF frequency bands. See Document 24/25.

[3] Telemetry, Commission for Communications Regulation, https://www.comreg.ie/industry/radio-spectrum/licensing/search-licence-type/telemetry/

Figure 1: Trends in demand for PMR licences



Licence holders fall across a wide range of industries and use cases in both the public and private sectors; several users hold licences in multiple categories. Only telemetry and PMSE licences are tied more closely to specific industries and/or use cases. Further details of the licence data are provided in Annex C.

Licence exemptions

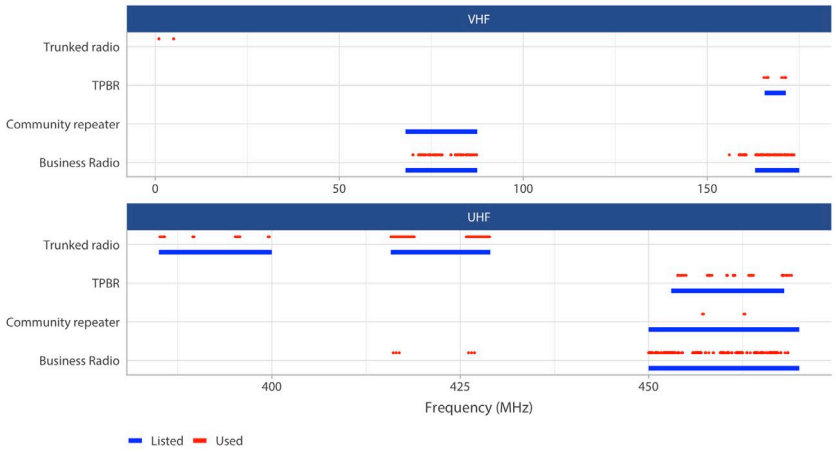
There are several devices operating in a PMR capacity that are exempt from ComReg licensing. These include short-range devices (SRDs), such as consumer-grade "walkie-talkies" and other small devices that are unlikely to cause interference issues. Exempt devices must meet certain technical requirements, outlined in ComReg Document 02/71R17.

2.2 Frequencies

The spectrum available for PMR is generally concentrated in the low VHF (68-87.5 MHz), high VHF (163-174 MHz), and UHF (450-470 MHz) bands. Within these bands, the specific frequencies available vary according to the licence type and equipment in use. Business radio licences and paging permits are available in all three of these bands, while other licence types are more limited in the bands in which they can be assigned.

The graph below shows the frequency ranges listed in ComReg's guidelines for each licence type as well as the specific channels in which there are active licences. There is substantial overlap in the ranges used for most of the licence types, with no clear split of licence types into different bands.

Figure 2: PMR frequencies



PMSE licences are available in a much wider range of frequency bands, reflecting the variety of technologies required for PMSE operations. PMSE licences are issued as temporary business radio licences, covering operation of typical PMR equipment (i.e. hand portables, base stations, repeaters) in the high VHF and UHF bands, as well as video and microphone equipment that is licensed in higher bands (i.e. L, S, C and X bands not shown in Figure 2.

Licence exempt frequencies

There are also ranges designated for use by licence-exempt PMR systems. These are primarily geared towards short-range devices (SRDs) and other systems that are unlikely to cause interference. SRDs are permitted to operate without a licence under a general authorisation in frequency ranges across several bands, provided they meet certain technical requirements, as laid out in ComReg Document 02/71R17. This includes use of 446.0 – 446.2 MHz, which is harmonised for personal use across Europe under ECC Decision (15)05.

Channel bandwidth

PMR licences are generally issued for a 2×12.5 kHz channel, but some 2×25 kHz channels are also in use due to legacy assignments still being in effect. Licensees may hold several channels which are not contagious (this is common for trunked radio operators), but this is generally because many users may operate on the pool of channels, not to support high bandwidth services.

Neighbouring users

The sub-1 GHz frequency ranges available for PMR are not currently shared with any other non-PMR users in Ireland. There are amateur satellite services and broadcast services operating in neighbouring frequencies, with the broadcasting frequencies being adjacent to the PMR range (i.e. broadcasting starts at 470 MHz). Block licences in the 400 MHz band have also been

allocated to ESBN (and are used for telemetry and control). Licence conditions and channel arrangements are aimed at efficient use of the radio spectrum whilst avoiding harmful interference between PMR and neighbouring users.

2.3 Licence conditions

Licence conditions (duration, geographic scope, technical requirements, etc) are currently set separately for each category of licence/permit.

Licence duration and renewal

Licence duration is one year for business radio, community repeater and trunked radio licences, five years for TPBR and up to six months for PMSE. Paging permits are not licences as such and do not have an expiry date.

One-year licences can be renewed annually (provided licence conditions are complied with and the licence renewal fee is paid by the renewal date), but there is no right to renewal for TPBR and PMSE (issued as temporary business radio) licence types, which must be reapplied for upon expiry (if made available by ComReg and if required). Organisations can only apply for TPBR licences when the application scheme is open, which has been every five years since its inception. ComReg has decided to reopen the TPBR scheme in September 2025.[4] Subject to the outcome of this PMR review and consultation, this may be the final opening of the TPBR scheme, but third party provision of PMR services will remain possible under some type of PMR licence.

Service areas

The various PMR licences differ in geographic scope:

- **Business radio** licences are local and regional, with coverage areas typically ranging from on-site to wide area licences covering up to a 35 km radius, depending on terrain and the general radio environment in the area. National business radio licences are currently not available.
- **TPBR** licences all have national coverage.
- **Trunked radio** licences can be issued as either on-site (at a specific premises or building site and within a 1-2 km radius from the licensed base station) or wide area (typically allowing for a coverage area of up to 25 km radius from the base station)

[4] ComReg 25/29

- **Community repeater** licences are generally issued for a coverage area of up to a 25 km radius from the base station.
- **PMSE** licences are issued for a specific location based on the event.
- **Paging** permits are typically issued for on-site or local area use.

PMR licences are subject to technical restrictions (e.g. power limits, equipment standards) aimed at efficient use of the radio spectrum, promoting good radio discipline and facilitating appropriate spectrum sharing. These technical limits are derived from the relevant ETSI standards and ECC/CEPT recommendations.

Coordination and coexistence management

PMR licences (with the exception of TPBR) are generally issued on a shared use basis. Equipment standards and other operating conditions limit the potential for interference among users, and ComReg offers guidelines on tone control practices that allow more than one business radio user to operate on the same channel. Provided that these techniques are implemented, PMR operators in overlapping areas can use the same channels without experiencing harmful interference.

When necessary, ComReg will undertake national and cross-border co-ordination procedures with other bodies or administrations.

2.4 Fee structure

Fees are set independently for each licence category and can depend on the geographic scope of the licence and equipment used:

- **Business radio** fees consist of a €22 admin fee and a further €22 per radio (or €12 for both admin fee and per radio fee for temporary licences);
- **TPBR** fees are €5,000 for the five-year licence;
- **Trunked Radio** fees are €625 per base station in the first year and €1,000 per base station for each renewal;
- **Community repeater** fees are €625 plus a €12 processing fee in the first year, and €1,000 per year each subsequent renewal;
- **PMSE** licences are issued as temporary business radio licences, attracting the €12 fixed plus €12 per radio fees; whereas

- **Paging** permits have no fee.

Further details of the current PMR bands and the specific fee structure are provided in Annex A to this document.

3 Use cases

3.1 Use cases

Private mobile radio is employed for various use cases across a broad range of sectors in the Irish economy. Most commonly, PMR is used for voice communication in various settings.

The main uses of PMR systems fall into the following categories:

- **on-site communication**, such as talkback systems used at factories, hospitals, and construction sites;
- **wide-area communication**, including uses for transportation, logistics companies, emergency services and search and rescue operations. This can be one-to-one communications or, more frequently, communications from a central command centre to many recipients throughout the licensed area;
- **events and broadcasting**, both in the production of the events themselves and their broadcasting; and
- **telemetry and control**, primarily used by utilities companies to monitor and report back to a command centre frequent readings and critical operating information.

This list refers to *end use cases*, whereas some licensees are third party providers (e.g. whose clients require PMR equipment for on-site communication).

Most PMR users will only operate in one of these usage categories, whereas others may use a combination covering different aspects of their operations. Likewise, the different licence types in the current ComReg PMR framework can be used in more than one of these cases.

Specific operators falling within each of these use cases may need quite different types and quantities of equipment (e.g. hand portables, repeaters, base stations, a mixture of analogue and digital equipment) depending on the coverage area and nature of the communication (e.g. one-to-one or one-to-many). PMSE operators may take out temporary broadcasting, point-to-point or satellite Earth station licences, in addition to temporary business radio licences, as set out in the PMSE guidelines.

Telemetry and control is naturally suited to telemetry licences, but in the past has also utilised other PMR licence types (e.g.

business radio frequencies for localised use for a period of time or TPBR for larger/longer term deployments). This use case continues to be important. While it may cease to be a PMR use case in the future (i.e. relying exclusively on telemetry licences), it is appropriate to consider so that any recommended changes to the PMR licence regime do not create unintended consequences for telemetry operators in the meantime.[5]

Holders of TPBR licences may use them to provide services to third parties (some also use them to secure exclusive access to channels for their own use). However, the end use case will generally be one of those in our list above, so third party PMR provision should not be thought of as a separate use case.

3.2 Sectors

A single operator may use PMR licences for more than one of the use cases listed above. Operator needs vary, for example in terms of the coverage area they require. The sectors that use PMR the most, based on our understanding from the licence data, stakeholder interviews and survey responses, are outlined below.

Transportation and logistics

Both passenger transportation services, such as buses and taxis, as well as logistic companies, use wide-area communications systems. In these cases, PMR is typically used to send mass communications (e.g. communications from a central control centre to all vehicles on the road) or communications between vehicles. This category primarily comprises private companies but also includes state-owned public transport companies. These systems organise the operation of vehicles while also providing an important line of safety for drivers and their passengers. Public transport companies (Dublin Bus, Luas) are some of the primary users of trunked radio licences for this

[5] We also note ComReg's position that the consideration of a new telemetry framework will be more informative closer to the expiry of the 400 MHz Band when the use of smart grids will have evolved significantly and there will be greater information available about future use cases and how the Telemetry Bands can be used given the development of a national Smart Grid by ESBN (see ComReg 24/25). A new fees regime will necessarily form part of such a review and neither the fees nor the telemetry licence framework more broadly should be constrained in any way by the recommendations in this report.

purpose, while taxi companies generally use business radio licences.

Security

Security personnel primarily use talkback ("walkie-talkie") systems for on-site communication needs, operating under the business radio framework. PMR systems for security are used at a variety of sites such as hospitals, schools and universities, factories, as well as by security teams deployed at temporary events and construction zones. Larger security firms, which provide and manage security systems for many sites and clients, also operate monitoring sites across the country (e.g. for remote monitoring of alarm systems). While interviewees stated monitoring sites are now likely to use broadband data as the primary source of communications, PMR can be employed as a reliable backup network.

Manufacturing

Manufacturing companies use PMR for on-site communications at factories, warehouses, and/or distribution centres. These sites, often very large, rely on quick and reliable communication among workers to ensure functioning and safety, making PMR a critical piece of manufacturing infrastructure. Depending on the company, the use of PMR may also be connected to transportation and logistics operations, for example if a user is involved in both manufacturing and distribution/delivery.

Construction

Like those at manufacturing sites, workers on construction sites use PMR to communicate with others on-site and operate safely and efficiently. This typically takes the form of talkback systems.

A subset of this is crane operation, which requires precise and near-instantaneous communication between the crane operator and the construction staff on the ground. Crane operation brings potentially greater coordination challenges than some other cases of on-site communication as surrounding buildings are less likely to constrain propagation of signals from cranes owing to their height. It can also potentially contribute to short term localised congestion because it is erratic in nature (i.e.

there can be lots of construction clustered in an area for a relatively short period of time).

This consultation welcomes further information and views from stakeholders on the ongoing use of PMR for crane operation.

Events

PMSE equipment is used at events across Ireland in both the functioning and broadcast of the event in question. These special events include sporting events, concerts, festivals, and state/government events, to name a few. Events require on-site radio systems for performers and production teams. This sector also includes elements of outside broadcast when on-site events are recorded and broadcast to a wider audience.

Events also might require standard PMR equipment (e.g. walkie-talkies) to facilitate on-site medical and security services, particularly at large events. There is an obvious overlap between this type of PMR use and that described in the sections on use in the security and emergency services sectors, which are necessary components of these large events.

Many, but not all, events will involve outdoor broadcast (OB) operations, commonly used to broadcast live sporting events, is a significant and growing segment of PMR licences. OB providers use extensive and varied equipment (walkie talkies, radio mics, radio cameras, inner-ear monitoring systems, etc) and therefore have varied needs when it comes to frequencies, bandwidth, and technical conditions. When broadcasting these events, several users are concentrated at a given location and time, while there are sufficient channels to accommodate this use, unlicensed use occurs at these events, which can increase the risk of interference among PMR users.

Utilities

Utility companies use PMR in multiple ways, employing business radio and TPBR licences as well as telemetry licences. Telemetry licences are used as part of complex monitoring and control systems. These polling systems are mission critical and must be continuously functional to ensure operation.

Utilities operate across two of the use cases listed above – on-site communication and telemetry and control – with the latter having distinct requirements (i.e. additional need for reliability)

and usage patterns (continuous polling between fixed points, rather than push to talk communication as required).

Naturally, telemetry licences are important for utilities, and business radio licences are also used for on-site communication at local stations. However, the use cases are not perfectly divided into licence types – telemetry operation has used business radio licences (often before the telemetry scheme was in place) and TPBR licences because the telemetry licences do not allow third party provision. However, this is mostly an issue for legacy equipment or because of historic idiosyncrasies in the licence types available. Going forward, we expect telemetry operation to generally use telemetry licences .

Healthcare/Retail/Other

Healthcare and retail services are just two of the sectors that use PMR, usually business radio and/or paging, for day-to-day operations. Generally, PMR can be and is used in any setting requiring the coordination of multiple people across a large business site or area. On-site examples are health clinics, hotels, department stores, and shopping centres, while tourism and outdoor activity operators are among the wide-area users.

4 Spectrum

4.1 Frequency assignment

Different licence types share the same broad PMR bands

As discussed in 2.2, PMR frequencies are concentrated in the VHF (high and low) and UHF bands, with all licence types being granted for frequencies in both bands, while PMSE also uses higher frequency bands for equipment such as cameras and microphones. There is no natural division of these frequency ranges into distinct bands for specific types of PMR licence. Channels are assigned to business radio, community repeaters, and TPBR, throughout the 450 and 470 MHz ranges. Similarly, channels allocated to multiple licences are in overlapping ranges of the VHF bands 68-87.50 MHz and 163-174 MHz.

In general, we are not aware of any need from a technical/equipment perspective for different licence types to sit within any particular area of these bands, as the same equipment can often be used under different categories of PMR licence. The exception to this is trunked radio, for which UHF channels are all below 450 MHz. Even in this case, some frequencies open to trunked radio (i.e. 410-430 MHz) are covered by the same ECC recommendation as those open to other PMR licence types.[6] Overall, it is unclear to what extent distinctions between different licence types within the band plan are necessary.

But ComReg assigns individual channels in an orderly way

Frequency assignment under the current framework is based on a first-come-first-served protocol. Upon application, potential licensees specify the necessary band, but the specific frequencies on the licence are determined by ComReg.

4.2 Potential for congestion

Risk of congestion is limited by PMR operator's ability to share spectrum

For the most part, there is no evidence of scarcity of PMR spectrum at present and stakeholders have not faced issues in obtaining licences for their desired frequencies. Some stakeholders commented that the amount of spectrum available to PMR has declined or is expected decline over time, mostly with regards to PMSE channels (e.g. in the 600 MHz band that is used now used for MFCN in some countries, particularly North

[6] ECC/Dec/(19)02

America), but this has not significantly constrained their ability to access channels. There is scope for PMR licensees to use the same channels, and therefore relatively little risk of congestion, because:

- on-site and wide-area PMR operations are geographically confined and should not interfere with or experience interference from other geographically defined licensees; and
- most PMR licences are shared use, and can use tone control techniques, channel access codes, etc. to use the same channels in overlapping areas without harmful interference.

ComReg's licence data, as set out in Annex C does not indicate a material risk of congestion. While a large proportion of licences are concentrated in the Dublin area, they have not exhausted the supply of channels within the ranges open to PMR and, given that a large share of PMR licences are used for on-site communications, there is considerable scope for reuse of frequencies without precluding another site from interference-free access to the spectrum. Provided that these opportunities for spectrum sharing are exploited, spectrum scarcity currently appears unlikely.

Nevertheless, certain types of operators might struggle to access spectrum

A small number of stakeholders have reported some difficulty in accessing channels, primarily in the Dublin area, but this appears to be a transient coordination issue among users concentrated in small areas, often arising temporarily during waves of heavy construction activity (in particular because of the number of cranes involved.

It is prudent for ComReg to monitor PMR usage over time in case scarcity should emerge in future. However, our view is that the more likely scenario is one of local coordination issues creating a risk of interference, which is not an issue of insufficient spectrum. We discuss this further in Section 5.

There are no general trends in PMR demand that suggest spectrum scarcity will emerge

We do not expect significant changes in demand for PMR frequencies to create spectrum scarcity in the foreseeable future. There is no particular trend in demand for channels in ComReg's licensing data and stakeholders typically expected their demand for PMR spectrum to be roughly constant over time. There are some technological developments that could broaden the range of alternative options available to PMR operators (which, if anything, would reduce demand for PMR licences rather than lead to scarcity), e.g. use of push to talk over cellular (PoC) technology. This uses mobile networks to provide similar services to traditional PMR equipment, but these

are not relied upon by many PMR operators and are not expected to substantially affect PMR demand.

Unnecessarily using spectrum on a national, exclusive basis creates potential scarcity

All allocated TPBR channels were assigned at the end of the last TPBR application round. We cannot assess whether there is excess demand for TPBR channels using licence data alone as, while some licences have been cancelled, new licences are not granted outside of the application window. However, ComReg received no responses to its proposal to keep the number of TPBR channels the same in its recent consultation[7], suggesting that there is no excess demand at this point. Nevertheless, under this setup ComReg can only respond to changes in TPBR demand infrequently – if all types of PMR licence had access to all available PMR channels (rather than a fixed number being assigned to TPBR), this avoids risking artificial scarcity for one type of licence when there is no spectrum scarcity overall.

Further, operators might currently choose a TPBR licence due to particular conditions it sets. Based on interviews we understand that some operators require the exclusivity a current TPBR licence offers, but not the national scope, while others require the national scope but could operate with a non-exclusive licence. Under the current regime, applicants must choose between a licence that is both national and exclusive (TPBR) or a licence that is neither. Similarly, some TPBR licences require the ability to provide services to third parties, but they cannot flexibly pair this with other licence parameters, e.g. as a regional third-party provider. It would be more efficient if licensees could select the features (geographic scope, exclusivity, etc) which they require for operation, and no more. This approach is adopted under our proposals for a consolidated PMR licence, discussed in Section 6.

While congestion is unlikely to arise if spectrum sharing opportunities are properly exploited, there is potential scarcity if many users demand access to channels on a national exclusive basis. There is an ample supply of channels available to meet current PMR needs, but to protect this supply going forwards, ComReg should provide licences that are flexible enough to support different types of operation, such as shared national licences (national business radio licences are not currently available), and incentivise operators to take up licences that do not exceed their needs.

[7] ComReg 25/29

4.3 New bands

Stakeholders expressed little demand for other bands to be opened to PMR, noting the absence of scarcity and the benefit of using equipment already tuned to currently available channels. The one band that did come up, however, was the UHF 1 band. The UHF 2 (450-470 MHz) band has long been used by PMR in the Republic of Ireland, with trunked radio being the only PMR licence type with access to the UHF 1 band (410-450 MHz). In Northern Ireland, on the other hand, Ofcom has historically used the UHF 1 band instead of UHF 2, but Ofcom has now updated its band plan so that PMR operators have wider access to both UHF bands in the United Kingdom. Stakeholders have requested that ComReg examines the possibility of doing the same.

The ECC has identified a range of bands suitable for PMR, which includes the 68-87.50 MHz, 163-174 MHz, 385-400 MHz, 415-429 MHz and 450-470 MHz ranges that is generally available for PMR in Ireland, UHF band 1 spectrum that is currently only available to trunked radio and other UHF frequency ranges that are not open to PMR in Ireland (including the 440-450 MHz range that some stakeholders expressed interest in). Some of these bands are unavailable for PMR in Ireland on the same terms as other PMR frequencies, e.g. because they are in use for smart grids or they are designated for simplex operation. The ECC recommends that NRAs select channels from these ranges to satisfy demand for spectrum from PMR operators, meaning that ComReg can open additional UHF band 1 spectrum[8] for all PMR users while acting in line with European harmonisation measures, but is not required to do so if the already available spectrum is sufficient.

On one hand, we understand the desire for band alignment across the island of Ireland – access to the same spectrum in both jurisdictions is convenient for operators who can easily re-use the same equipment. However, this is already possible as Ofcom has opened the UHF 2 band. If the existing PMR spectrum was insufficient to meet operators' needs, UHF band 1 would be a natural candidate to open. This could even be done temporarily, in specific areas, if there were short run congestion

[8] In practice, only the 440-450 MHz range might be suitable which, under the terms set out in ERC T/R25-08, would be used as a simplex band. Other UHF band 1 spectrum is designated for other services such as BB-PPDR (see ComReg 20/98).

issues (noting that this could not include the renewal rights available under some existing PMR licences).

With no observed spectrum scarcity and all use cases and sectors able to operate within the currently allocated spectrum, we do not see a convincing argument to open more frequencies for PMR use. All current sub-1 GHz PMR bands are allocated on a primary, non-shared basis, doing the same in the UHF 1 band could complicate, without good reason, the band's use by others with a more compelling need for additional spectrum in the future (potentially including BB-PPDR or further use by utilities). In general, we would recommend opening new bands if they were both used for PMR internationally and required by PMR operators to provide a reasonable quality of service, but the latter point does not appear to be the case. Subject to any further views raised in stakeholders' consultation responses, we do not recommend adding any new bands to the PMR framework at present.

4.4 PMSE bands

PMSE licences also have access to higher frequency bands, used for wireless microphones, IEMs and wireless cameras, including spectrum in the 470-694 MHz range (the 'sub-700 MHz band'). We understand that ComReg is currently gathering information into future use of the sub-700 MHz band[9], covering scenarios in which PMSE spectrum in the band is maintained, reduced, or the service is migrated from the band entirely. There is an expectation that Europe will follow North America in making spectrum in the sub-700 MHz band available to mobile operators, which will reduce the range of frequencies available for PMSE. This is unlikely to cause a problem in Ireland provided sufficient notice (1-2 years) is provided in advance. Wireless audio equipment is available in higher frequency bands that are already open to PMSE, in particular the 2.4 GHz band, although these frequencies have inferior propagation and greater risk of interference from neighbouring services. PMSE operators will continue to have access to usable spectrum if they are moved from the currently used spectrum below 700 MHz.

No changes to the bands available to PMSE are required at present, but operators should be aware of the separate ComReg review and subsequent consultation process.

[9] ComReg 34/99a

5 Interference issues

As discussed above, despite there being occasional issues accessing clean channels for certain types of users and in certain locations, there is no convincing reason to think that the supply of PMR spectrum is close to being exhausted. However, this spectrum must still be used efficiently, i.e. by adhering to the technical conditions on PMR licences that make spectrum sharing possible. If operators do not, then others are likely to experience interference.

Harmful interference is an issue for PMSE operators

There is a clear divide in PMR stakeholders' experience of harmful interference between PMSE operators and holders of other types of PMR licences. For the latter, interference tended not to be an issue, although there were some exceptions (e.g. relating to cranes using an old licence on a new site). On the other hand, PMSE operators reported significant problems of dealing with harmful interference, primarily as a result of unlicensed operation, whereby the licensed PMSE operator often finds that its assigned channel is in use by an unlicensed operator.

5.1 PMSE interference

In the stakeholder interviews, PMSE operators described experiencing harmful interference from unlicensed operation of PMSE equipment by other operators. In their view, there was not sufficient real-time support from ComReg (either on-site enforcement or remote contacts) to allow them to address the issue while operating within the parameters of their licences, and instead they often resort to 'self-managing' the licences, organising themselves into unused frequencies by coordinating with other operators at the same event.

PMSE is generally a secondary use case when sharing with primary users such as Broacasting in 470 MHz – 694 MHz and ComReg issues PMSE licences on a non-interference, non-protected basis. From a general spectrum management point of view, ComReg has an interest in stopping operators who neither hold a licence nor benefit from a licence exemption from using the spectrum. However, if there are economical, lightweight measures that can help ensure useable spectrum is available for PMSE operators, then it is not reasonable to expect ComReg to

undertake further costly interventions to protect operators who are licensed to operate on a non-protected basis.

Additional on-site enforcement is excessively costly and not appropriate for licensees operating on a non-protected basis

The most direct means of addressing unlicensed operation at events would be additional on-site monitoring. We understand that ComReg already provides on-site presence at large events (typically one-off events lasting several days) and expanding the events it attends to cover all cases of PMSE interference may be excessively costly, as enforcement at special events is resource and personnel intensive. ComReg's enforcement operations are capacity constrained, and presence at additional events would take resources and personnel away from other spectrum management and monitoring obligations. The increased administrative costs of this, or any other measure added to the PMR framework, would ultimately have to be recovered through the fees paid by PMSE operator. Therefore it is only in PMSE operators' interests for ComReg to increase on-site enforcement if no more cost-effective solutions are available.

Given ComReg's capacity constraints, it is at least as cost-effective for operators to organise third-party spectrum monitoring services directly, rather than through ComReg. Even at events where there is no on-site ComReg presence, it is in operators' interests to report incidents of interference to ComReg. While this will not resolve interference at that particular event, it does give ComReg the opportunity to identify offending parties and remind them of their licensing obligations and useful information to consider in future resourcing processes, which could help avoid interference at future events.

Automated licence amendments can mitigate the effects of interference

As a more practical alternative to additional on-site presence, ComReg might consider implementing a system that allows for automatic licence amendments, thereby authorising operators to move to a free channel if they experience harmful interference. These amendments should be free of charge provided that the new licence would not have cost more than the initial licence, had it been applied for in the first instance (i.e. the operator is asking for a different channel of the same size, not for more spectrum, or a larger coverage area). This would leverage the fact that there is generally enough spectrum to accommodate all operators and would formalise and provide additional information (i.e. an up-to-date list of available channels) to the process where PMSE operators switch channels in response to interference.

We note that ComReg's existing licensing process in any case allows for operators to apply for licences at any time. It would

be consistent with this to allow an amendment in limited circumstances, namely where an operator with an existing licence wishes to switch channel due to interference. However, it is for ComReg to assess the feasibility of this given its current licensing system and whether the change would be proportional to the needs of (non-protected) PMSE operators.

5.2 Spectrum sharing

Holders of other PMR licence types are much less likely to experience harmful interference than PMSE operators. However, PMR usage is relatively extensive in Dublin (particularly during intense periods of construction), and interference issues related to some uses (e.g. unlicensed, crane control, construction) sometimes arise due to:

- PMR users operating without a licence or mistakenly on the wrong channel;
- use of the spectrum high up creating a larger geographic footprint of the signal than the licensed area;
- users moving sites but not getting new licences for the new location; and/or
- operators not keeping to the power limits specified in their licence.

Similar issues of interference can also arise, although with lower probability, even in areas with lower levels of PMR use and no prospect of spectrum scarcity if spectrum is used illegally or in ways that do not adhere to licence conditions.

However, as these problems are mostly a case of operators failing to meet the conditions of their licences and operate in a way that supports spectrum sharing, they can largely be avoided if operators follow ComReg's technical guidelines. Where interference is a result of unlicensed operations, ComReg has powers under the Wireless Telegraphy Act 1926 to prosecute offenders, which may lead to a fine.

Technical measures like tone control facilitate spectrum sharing

ComReg's PMR guidelines documents and the relevant ETSI documents set out technical conditions on power limits, equipment standards, and operational procedures such as tone control that allow effective sharing of PMR spectrum. Failure to comply with these guidelines reduces the scope for spectrum sharing, when the number of operators that can be accommodated on the available spectrum is reduced and can impact on efficiency of spectrum use. Costs of dealing with

interference can then arise without there being any spectrum scarcity. However, we do not see any need for changes to the PMR framework because of this. Unlike the PMSE case (which is more to do with completely unlicensed operation), our understanding is that harmful interference on other PMR licences is infrequent, and that spectrum sharing is generally successful.

Even when there is interference between operators, this might not be to the extent that it would be considered harmful. Furthermore, the inherent ability of PMR operators (applying appropriate technical measures) to share spectrum has been used in the design of other PMR licensing regimes. For example, Ofcom issues technically assigned licences permitting the use of spectrum which is shared by up to four users.[10] The ECC has supported such approaches to spectrum sharing, and notes that they are suitable for the types of traffic found among some PMR use cases, where voice or data is transmitted only for short intervals of time, rather than continuously.[11] In these cases, there is a high probability that two operators sharing a channel would actively use it at different times, and therefore, while there might be some clashes, these do not harm either's operation.

[10] https://www.ofcom.org.uk/siteassets/resources/documents/consultations/uncategorised/95984-strategic-review-of-uhf-band-1-and-band-2/associated-documents/statement-on-strategic-review-of-uhf-band-1-and-band-2.pdf?v=322497

[11] ECC Report 292

6 Licence types and consolidation

6.1 Alignment with use cases and best practice

ComReg offers a broad suite of PMR licence types, some of which are linked to particular technologies or use cases. Business radio regulations were originally put in place in 1949 and the set of PMR licences has grown organically, addressing technology specific requirements as they arose. Unsurprisingly, there is considerable overlap between the spectrum, equipment and technical conditions associated with different licence types and these current licence types are not well aligned with the use cases identified in Section 3.

The exception to this is PMSE licences, which, in addition to the usual VHF and UHF bands, make use of various higher frequency bands for different types of equipment. PMSE licences also have a significantly shorter licence duration (no more than six months) compared to the standard annually renewable licences offered under other PMR categories.

On the other hand, there are gaps in the combinations of licence characteristics that are on offer. In particular, TPBR licences have a longer duration of five years (without the same renewal rights as annual licences), are national and provide exclusive access to a channel, but there is no option to have a national business radio licence. Several TPBR licence holders are interested in the licence because it offers exclusive, national access to channels, often for their own use, not because of the option to provide to third parties. Moreover, as the end use cases are the same, there is not necessarily any need to have a licence type aimed at third party providers of PMR services.

Furthermore, we do not see any need for licence types to be tied to specific types of PMR technology. The ECC documents currently applicable to PMR are technology neutral (see Annex B for a summary of the relevant ECC Decisions and ECC Report 292). Similarly, common ETSI standards cover multiple types of equipment. Alignment with best practice throughout Europe would not require different types of PMR systems/equipment to be covered by a separate licence type.

The divisions between existing PMR licence types are arbitrary

Therefore, in our view the distinctions between the existing PMR licence types are somewhat arbitrary and not well aligned with prevailing use cases or international best practice, revealing scope for consolidation.

In response to the survey, stakeholders tended to be in favour of a consolidated licence type being introduced, but often wanted business radio licences to be maintained. However, the requirement was that operations currently undertaken using a business radio licence should still be possible, rather than that the business radio licence needs to be formally distinct from a consolidated licence. The licence parameters that were identified as important were the same across users of different licence types, namely exclusive access to channels and appropriate geographic scope. There was also support for a national business radio licence.

On this basis, we believe that consolidating the licence types would be in the interests of stakeholders. We expect that it would also be easier for ComReg to manage and monitor compared to a system with seven different licensing regimes.

6.2 Consolidated PMR licence

In place of the range of licence types currently on offer, we recommend that ComReg introduces a consolidated PMR licence. We recommend that PMSE licences remain separate from the consolidated PMR licence and discuss these in the next subsection.

6.2.1 Structure of consolidated licence

An annual, renewable, technology and service neutral licence

A consolidated PMR licence would be an annual licence with renewal rights, permitting the holder to operate any PMR equipment, with no limit on the number of pieces of equipment, subject to technical restrictions derived from the relevant standards and regulations (e.g.CEPT or ETSI standards). Licence holders would be free to make use of the licence themselves or provide services to third parties (in the same way that serving third parties is currently possible using TPBR licences). Licences would be assigned on a first come first served basis.

Some stakeholders have expressed a preference for licences with a longer duration, but we believe that similar benefits and investment incentives can be achieved through annual licences,

provided that holders have a strong expectation that licences can readily be renewed. ComReg would continue to renew the licences unless it had a strong reason to repurpose the spectrum (e.g. to remain aligned with international harmonisation decisions), and even then would provide ample notice for any affected licensees. This is in keeping with ComReg's approach in its other licensing frameworks (such as fixed links and satellite Earth station licences) and is supported by the PMR licensees' experiences i.e. under the current regime, licensees have reliably been able to renew annual licences (where annual licences are used). Should ComReg restructure the PMR licensing framework in accordance with our recommendations, operators would continue to have access to the spectrum they are currently using.

The consolidated PMR licence would be a technology and service neutral licence, in that all PMR equipment and use cases would be permitted under it. Technical conditions would be defined for each type of PMR equipment in line with CEPT and/or ETSI standards. In practice these would be very similar to many of the existing technical restrictions. It is already the case that many of the technical restrictions are specific to types of equipment rather than licence types, and that similar equipment is used across different licence types.

PMR licensees will have different geographic scopes, frequencies and sharing requirements

The consolidated licence would have the following parameters, which are closely related to the parameters identified by stakeholders as the most important.

Geographic scope – three geographically differentiated licence types would be on offer:

- on-site, possibly subject to tighter power limits and antenna height restrictions, as is the case for existing on-site business radio licences;
- wide-area, for which the licence applicant would provide the locations of its base station(s) and the size of the coverage area it requires, subject to a general obligation not to claim unnecessarily large coverage areas, and potentially with a requirement to justify the size of the coverage area requested on application; and
- national.

Coverage area definition is simple for on-site and national licences. For wide-area licences, licensees do not have complete discretion over the shape and size of their coverage area, which in most cases will be determined by base station locations. In the simple case, the wide area licence will cover a circle around

a base station, with the licensee notifying ComReg of the proposed base station location and requesting a certain radius around this. Operating multiple base stations, or no base stations and instead just using handheld-to-handheld communication, will both also be permitted. Handheld only licensees can nominate a location, allowing coverage areas to be defined in a similar way without the need to deploy a base station.

A licence would cover a single contiguous area. Operators with two or more sites that are distant from each other would require more than one licence. Where multiple base stations are operated under a single licence, there should not be large gaps between these in which the licensee is not using the – for example, an operator wanting to use the same frequencies in Dublin and Cork (but none of the areas in between) would require two licences. The exact shape of the coverage area for licences covering multiple base stations (those that are not simply a circle around a central point) would be determined by ComReg using the same principle of coverage of a radius around base stations, i.e. a licence covering the union of the areas covered by each base stations.

Licensees operating in two or more separate areas might have a mild incentive under the fees to join these together under a single licence, with a coverage area that does not reflect its actual requirements. This could inefficiently restrict access to those frequencies to other users operating between the sites, therefore ComReg would not grant coverage areas that did not reflect the licensee's needs. ComReg should impose a minimum coverage area around any base station, to prevent operators attempting to join up separate areas with narrow channels of coverage for the sole reason of reducing fees, but it can retain discretion over coverage area assessment and may consider irregular coverage in exceptional circumstances.

In principle, ComReg could set size limits on the coverage areas for wide area licences, but this is not necessary if the operators are required to justify the size of the requested coverage area. To avoid being presumptive about what coverage areas there might be demand for, we do not recommend setting blanket size limits on wide-area PMR coverage areas (there may nevertheless be guidance on coverage area size that is derived from other licence conditions, e.g. power limits).

Channels would be available in the 450-470 MHz range of the UHF band, and in both the VHF frequency ranges open to the existing PMR licence types (68-87.5 MHz and 163-174 MHz).

Existing trunked radio operators would be permitted to continue on channels in the 410-430 MHz range, but these would not be available for new licences – the additional spectrum is not needed to meet PMR demand and overly fragmented allocations might create transition issues in future. These would typically be 12.5 kHz duplex channels, but there should also be options for 6.25 kHz (which are not widely used, but can be with digital equipment) and 25 kHz channels (currently available under trunked radio and community repeater schemes). Unpaired operation is also permitted. Operators may request several channels and can indicate whether these must be contiguous. ComReg retains discretion over which specific frequencies to assign, but operators can express a preference for certain channels. ComReg will respect the operator's preference for the VHF or UHF band, but will consider more specific preferences only if it does not conflict with other users or spectrum management objectives.

While the consolidated licence is neutral, ComReg should still collect information on type of use, including whether the licensee intends to provide PMR services to third parties, as part of the application process – this would not play any part in ComReg's assessment of whether or not to grant a licence, but it could be used to, for example, determine which channel to assign the licensee. Such data is also of value to any future licensing review exercise.

Exclusivity – by default, PMR licences would be shared use licences, but operators would be able to request exclusive use licences. In these cases, the applicant would be required to provide ComReg with a justification as to why exclusive use is required. Shared use in this context means that multiple operators with overlapping coverage areas could be assigned the same channel and should make use of spectrum management techniques like tone control and channel access codes to share the channel without harmful interference. For the avoidance of doubt:

- exclusive use does not extend beyond the licence coverage area or in any way constrain ComReg's ability to issue licences for the same channel outside of this area (subject to any relevant interference checks); and
- shared use licences do not constrain ComReg's ability to issue other licences in any way (but would be considered during standard checks when processing licence applications).

Both exclusive and shared use status could be combined with any geographic scope option.

Ofcom sets a 'sharing factor' for some of its PMR licences that caps the number of licensees that will be assigned the same channel in an area. This could be included in the consolidated PMR licence as a minor alteration to our proposal, but we do not believe it is necessary. It would also come with a minor cost to flexibility, if the appropriate sharing factor were to change over time or depend on case specific factors such as the extent of the overlap of coverage areas or the nature of the business of licence holders. While ComReg may issue guidance on the likely maximum number of users sharing a channel, we do not recommend ComReg sets a formal sharing factor unless consultation respondents identify valid reasons for why that would be helpful.

Division of channels by geographic scope does not need to be fixed ex ante

It is not obvious what the appropriate split of channels between national and geographically constrained licences should be, as demand under the new licence regime is uncertain. ComReg does not need to determine this split ex ante, rather we suggest it should assign channels with a view to minimising the risk of regional licences inefficiently limiting availability of national licences. More generally, ComReg can think of complementary licences as any that can use the same channel without harmful interference, either because they are shared use licences or because of their non-overlapping geographic scope and it can assign complementary licences the same channels as much as possible. Given that there is little evidence of spectrum scarcity, most channel widths are the same (i.e. 12.5 kHz) and bandwidth requirements are fairly static, there are many different ways to arrange licences without unnecessarily fragmenting the band.

Existing PMR licences are reasonably well arranged in the available spectrum, with the same or neighbouring channels often being used quite heavily by non-conflicting licensees. However, there are no formal guidelines to ensure that this is done consistently. We recommend that ComReg sets out some guidelines on how it will assign channels, which could run as follows:

- first identify channels that are already relatively heavily used for PMR (to maximise order within PMR channels without having to reorganise existing users);
- next, assess whether the new application would be complementary with one of the already used channels and if so, assign it to that channel – this step can take account

of applicant preferences (e.g. if an operator has requested a specific frequency that it already uses in another location);
- if not, place it in a channel adjacent to one that is already in use.

Excessive concentration of spectrum is unlikely

In theory, competition issues could emerge under the consolidated PMR licence if a small number of licensees were to take out national exclusive use licences (or wide-area licences in some cases) for most of the available channels. This would create artificial scarcity of spectrum for other operators and could be problematic in the case of third-party provision. We do not expect this to be likely in practice and we believe that ComReg's general spectrum management powers, coupled with guidance about licences reflecting the holder's actual need, will be sufficient to address any issues of this sort, should they arise. We do not think hard restrictions, such as caps on the number of channels a licensee can have, are required.

Nevertheless, checks that licences actually reflect the holder's needs are prudent. At the application stage, this would be justification, e.g. that a channel is required constantly, if the application is for exclusive use. Once issued, there should be some rollout conditions, in particular checking that national licences are in use throughout the country – failure to actively use the licence within a year might lead to its coverage area being adjusted on licence renewal. Operators could prove use based on base station deployments or any other evidence of use of mobile devices and there should be some tolerance for coverage areas only moderately wider than that which licences can prove is in use (e.g. having a base station might be sufficient to demonstrate use in a county, but operating in a small number of counties is clearly not sufficient for a national licence). It is convenient to have access to a channel if the licensee expects to expand and begin operating in new locations in the near future (e.g. as a third party provider seeking new customers) and we would not expect the rollout conditions could balance this legitimate interest in wider coverage areas with the need for licences to reflect actual use. We expect that these checks would be fairly straightforward, and should not impose any great burden on operators, especially if licence amendments are available as needs evolve.

6.2.2 Transition arrangements

Existing holders of annual licences would transition automatically to the consolidated licence at licence renewal.

Other licence holders (notably TPBR) would have to apply for a new licence following expiry of their existing licence or may choose to hand back their current licence and apply immediately for a consolidated PMR licence. As some time is needed for this PMR consultation and for ComReg to subsequently make and implement a decision on the PMR review, the relevant TPBR licences are those that will be assigned in the 2025 TPBR application window opening shortly. ComReg has set a common end date in September 2030, such that TPBR licences assigned later in the window will have a shorter duration instead of delaying migration to the consolidated PMR licence.[12]

Existing licensees will not be required to change channel without notice or good reason

We are not proposing that ComReg forcibly reorganises existing PMR licensees. In particular, existing trunked radio licensees should be allowed to continue using the UHF channels below 400 MHz, even though these will not be open to new applications for consolidated PMR licences. The benefit of reorganising existing licences is limited by the fact that spectrum for PMR is not currently scarce, and the administrative burden on both ComReg and existing licensees, which, while relatively modest (it generally involves retuning existing equipment rather than replacing equipment) could be disproportionate to the benefit of reorganising them.

For the avoidance of doubt, existing trunked radio licences would still formally transition to a consolidated PMR licence, but as a legacy trunked radio operator, they would maintain access to the channel that they are currently using. New licences under which an operator intended to deploy a trunked radio system would not have access to the legacy trunked radio channels. This avoids unnecessary disruption to spectrum users while minimising transition issues that might arise in future, for example if spectrum in the 410-430 MHz range is assigned to BB-PPDR.[13] Some operators might naturally transition out of the legacy channels as they upgrade technology.

New licences would be assigned as described above and, over time, placement of PMR channels would converge to be filled up from specific points within the VHF and UHF bands. However, existing licensees should be aware that circumstances may change in future, whether that is in relation to parts of the band being needed for other services, or if congestion arises in certain locations. They may voluntarily switch channels at a time

[12] ComReg 25/29

[13] See ComReg 20/98

convenient to them to further reduce the (already relatively small) risk of having to move in future.

Should it become necessary to migrate existing licences from their current position in the band, ComReg should, as much as possible, provide reasonable notice to the licensees required to move, and to consult with them over the timeline for moving to new channels (ideally to align with times when they might need to replace/adjust equipment anyway).

6.3 PMSE licences

PMSE licences are generally issued as temporary business radio licences, which will no longer be possible if business radio licences are subsumed into the consolidated PMR licence. However, duration is not the only difference between PMSE and business radio licences, because PMSE licences:

- are issued on a non-interference, non-protected basis (PMSE is a secondary use case, but operators must hold a licence as it is not the subject of any licence exemption); and
- have access to additional, higher frequency bands suitable for other types of equipment (wireless cameras, in-ear microphones, etc).

In practice, we do not see any need for ComReg to make substantial changes to the PMSE licence structure. Standard business radio operation will continue to be possible (largely unchanged for many users) under the consolidated PMR licence, such that continuing to offer PMSE licences that are in effect identical to the ones on offer currently is possible.

PMSE licences are a distinct category, operating on a similar basis to existing PMSE licences

For clarity, we suggest that ComReg provides PMSE licences as a separate licence type (rather than describing it as a temporary PMR licence), under the same conditions as existing PMSE licences. This includes the provision that PMSE licences would be issued on a non-protected, non-interference basis.

PMSE operators have suggested various potential modifications to the PMSE licences (but none of these was consistently suggested by many stakeholders in the way that protection from unlicensed operation was). These include licences with:

- a wider coverage area (e.g. covering neighbouring venues);
- a longer duration; and
- shorter licences (e.g. 2-hour slots) covering only the precise period that is needed.

Other suggestions from PMSE operators were typically variations around these themes of providing flexibility or tailoring licence conditions to particular PMSE setups. We note that shorter licences might help to maintain accurate information about what spectrum is in use, but need not necessarily be charged lower fees, as most of the administrative cost to ComReg relates to processing the licence applications and renewals. Very short-term licences would lack the flexibility that many PMSE operators require and would not be appropriate in instances in which time was needed to set up equipment, or there were risks of events overrunning. Licences covering wider areas and longer time frames, on the other hand, are of limited benefit when there is ready availability of spectrum as well as other types of licence available. For example, a full PMR licence might be preferred if PMR equipment is needed repeatedly at the same location.

Overall, none of these structural changes appear to be of as much importance to operators as interference mitigation, and we are not convinced that any further changes to PMSE licences (beyond those aimed at interference management) would be proportionate to the issues raised.

7 Fees

7.1 Pricing objectives

Our proposed consolidated PMR licence would be a major restructuring of ComReg's PMR framework. This requires a new fee structure that treats all types of licensee consistently.

We have found no evidence of current spectrum scarcity (though scarcity is possible in the future in limited locations, likely in cities). Therefore, the level of the fees will primarily be set to recover the administrative costs to ComReg of operating the PMR licensing regime. On the other hand, the structure of the fees and the assumptions used to distribute costs must reflect the uncertainty around the numbers of consolidated licence of different types that will be taken up and also the potential for scarcity to arise if many of these licences are national or exclusive. A fees approach should encourage users to report their geographic requirements truthfully and only select national licences where one is required.

On this basis, we believe the following objectives for the new PMR fees schemes are appropriate:

- the level of fees should at least recover ComReg's **administrative costs** of assigning and managing PMR licences;
- the **distribution of costs** should not discourage use by smaller users;
- the structure of fees should **incentivise spectrum sharing** to avoid potential scarcity if operators have licences in excess of their needs; and,
- fees should be **predictable** for licensees and **practical** to implement for ComReg.
- the geographic scope of a licence should not extend beyond the area necessary to meet its intended use of the spectrum.

Many of the PMR fee structures have been in place for a long time and are not necessarily reflective of costs. In fact, they pre-date ComReg's general policy of indexing all fees to CPI inflation, meaning that licensees have enjoyed significant real-terms reductions in fees over the last 20 years. Fees for each type of licence were determined independently of each other and there is no consistent structure of the fees across licence

types – some are charged per piece of equipment (business radio), or per base station (trunked radio), while others are a flat fee per channel (TPBR). Nor is the level of the fees consistent across licences, with trunked radio licences standing out as relatively expensive, while TPBR licences are cheap – operating a single base station under a trunked radio licence costs as much per year[14] as a national, exclusive TPBR licence.

As a simple consequence of treating all licensees consistently under the consolidated licence, it is inevitable that licensees will be affected differentially by the changes in fees. For example, a consolidated approach cannot consistently charge based on equipment (as is the case under business radio and trunked) while simultaneously accommodating a TPBR approach which does not include an equipment charge and allows licensees to use spectrum independent of how many pieces of equipment they own.

We should pay particular attention that the structure of fees does not undermine third party provision of PMR services. Third party providers are an established part of the PMR landscape and help the spectrum be used more efficiently as they are well placed to monitor their customers' needs. This likely precludes charging per piece of equipment, which would place an administrative burden on third-party operators and would be difficult to set at a level that meaningfully differentiated between different amounts of equipment without the risk of undermining some third-party provider business cases. We see no strong need to maintain the per equipment charges that apply to other licence types, noting, for example, that the effect of per base station charges to trunked radio operators might already be achieved by charging based on coverage area. Furthermore, to the extent that equipment numbers might proxy the intensity of use of business radio licences (and therefore, how effective spectrum sharing might be), in an environment without spectrum scarcity this would not seem particularly important. Therefore, in the interests of both charging all licensees consistently and not undermining third party provision, we do not recommend charging per piece of equipment.

Where possible, ComReg should limit the changes in the level of fees to avoid unintended consequences. While this can be

[14] From the second year onwards, trunked radio licences cost €1,000 per base station (a rough proxy for geographic coverage) per channel. TPBR fees are €5,000 for five years, although this is paid up front rather than annually.

applied on aggregate and to the most common licence types, the variance in the current business radio fees (owing to equipment charging) will naturally be reduced and significant changes in the relative fees between licence types are necessary. Therefore, if simplifying and rationalising the current structure of five different licences (plus PMSE, which remains a separate licence type), ComReg cannot guarantee that some types of licensee would not face larger proportionate changes.

However, we expect larger changes to be mitigated by users making adjustments in response to the new licence structure. First and foremost, this is because certain types of licence are not currently available, but will be under the consolidated licence, such as national shared use licences, or regional licences that are exclusive or support third party provision. We understand that some TPBR licensees do not require the full extent of a TPBR licence and indeed that several of them are not operating nationally. Once the 'gaps' in the licensing regime are filled in they may adjust their licence parameters. We highlight that, while the analysis below is largely static (i.e. it does not make assumptions on licensees' responses to the proposed changes), current TPBR licensees might only pay a fraction of what is presented if they, for example, required exclusive access to channels in only part of the country.

Administrative cost should be distributed to avoid creating artificial scarcity or pricing off users

We suggest that fees are higher for exclusive licences and licences with larger coverage areas, because:

- ComReg's administrative costs are not entirely fixed and these licences place a slightly larger burden on ComReg in terms of processing applications and monitoring licences;
- ComReg should avoid creating incentives to claim larger coverage areas (e.g. national licences) than necessary or inefficiently use exclusive licences when the frequencies could be shared (applicants must justify why they need exclusivity or a certain coverage area, but there is nevertheless a role for fees in supporting this); and
- there is potential for artificial scarcity to be created if national exclusive licences are taken out where they are not required.

While licence fees should be set so that exclusive and/or national licences are more expensive relative to alternatives, ComReg should ensure all licensees pay some minimum amount (as they each cause some small incremental administrative cost).

Bandwidth

The vast majority of PMR licences use 12.5 kHz channels and bandwidth requirements are largely static over time. For presentation purposes, we therefore focus below on a fee per 2x12.5 kHz channel. However, 6.25 kHz channels can be used for digital equipment, while 25 kHz channels are currently used on some trunked radio licences. We recommend that licensees pay the same fee per kHz for these channels (i.e. the fee for a 6.25 kHz channel would be half the fee of a 12.5 kHz channel).

The fee structure should be futureproof

We also recommend features that ensure that fees are predictable and to minimise the risk of substantial changes in the near future.

First, it is possible that scarcity arises at some point in future, most likely in Dublin. While there is no need to apply congestion charges at present, we recommend that scope for regional price differences is included in the PMR framework as a future proofing measure. This is prudent given the uncertainty around demand for consolidated PMR licences.

Should this hypothetical congestion charge be required in the future, its level should reflect the value difference placed by marginally excluded users between having access to their preferred PMR spectrum and an alternative use, which might be a push-to-talk over mobile application. The appropriate level of any future congestion charge is uncertain, so ComReg should start with a modest fee once congestion is observed and implement gradual increases as needed.

Second, all PMR fees should be indexed to CPI, as is now standard practice across ComReg's various spectrum licensing regimes. This is the most practical and predictable way to ensure that fees keep roughly in line with ComReg's administrative costs over time.

7.2 Recommended PMR licence fees

To implement this administrative cost fee schedule, ComReg can use the following formula:

$$F(c, E) = \alpha[1 + \beta c]\gamma^{E}$$

Where:

- c is the coverage area of the licence, as a proportion of the area of the entire country ($c \in \{0,1\}$, with 0 for an on-site licence and 1 for a national licence);

- $E \in \{0,1\}$ is equal to 0 for shared licences, 1 for exclusive licences;
- α controls the overall level of the fees (and is the fee for an shared-use, on-site licence);
- β determines how much a national licence costs relative to an on-site licence; and
- γ is the proportionate premium paid for exclusive-use licences.

This formula applies to the fee per 2x12.5 kHz channel. Other channel widths and unpaired channels are also permitted and will be charged the same price per kHz, meaning an unpaired 12.5 kHz channel pays half this fee, as does a paired 6.25 kHz channel, while a paired 25 kHz channel pays double. For simplicity of presentation in the formula we focus only on the most common channel bandwidth. If a licence covers multiple channels, this formula applies to each channel and the channels fees are added together to give the licence fee.

Demand under the new licence structure is highly uncertain, especially as certain types of licence (e.g. national share-use licences) become available for the first time, which creates a case for limiting changes in fees, except where there is a strong reason to change them. For this reason, we suggest basing the difference in fees between national and on-site licences, β, on the difference in fees between existing licences. There are no directly equivalent licences fees to use, but TPBR licences and business radio licences are the closest equivalent, so we propose:

- divide the TPBR licence fees by five, giving an annual value of €1,000 (ignoring any discounting issues);
- take the median number of pieces of equipment for on-site business radio licences to calculate a typical business radio licence fee; then
- set β based such that the ratio of national and on-site licence fees is equal to the ratio of annual TPBR and typical on-site business radio licence fees, which gives $\beta = 4$.

This is at the lower end of where ComReg could reasonably set the parameter value while avoiding incentives to request excessive coverage area. For example, we note that a similar calculation based on the difference in telemetry licences fees would suggest a ratio between fees for the two licences types of around 60. However, a ratio that extreme would risk pricing off national third-party operators.

Then consider the premium for exclusive licences, γ. In practice, the number of operators that can share a channel in a given area is not fixed and may depend on the usage patterns of the particular licensees involved. We suggest that ComReg offers guidance that there will typically be no more than four operators sharing a channel in a given area, but we propose $\gamma = 3$, reflecting that, in practice, the number of operators sharing a channel is generally below the maximum.

Finally, α is set at whatever level is required to cover ComReg's administrative costs, under the assumption that the number of licences remains constant. Specifically, we divide total administrative costs by the total number of channels currently licensed to give the value of α, which is the minimum fee any PMR licensee would need to pay (i.e. for a 6.25 kHz on-site shared use licence, with wider coverage, greater bandwidth and/or exclusive use licences costing more). Based on current use, this would clearly lead to some over-recovery of costs. However, given the significant proposed changes to the licence structure and the fact that we cannot reasonably predict what users will need following the revisions, we consider it appropriate for ComReg to protect itself against the risk of significant under-recovery of costs (provided it does not impose large fee increases across the board that would inefficiently price off users). Moreover, the level of (and differences within) the fees must be sufficient to create meaningful incentives for efficient use of the spectrum. If users respond to these incentives, as we expect them to, we expect the changes to reduce overall revenue in time.

Given the other parameter values and assuming that:

- the number of PMR licensees remains constant except for paging permits;
- we exclude paging permits from this analysis, as they do not expire and thus their numbers in use are highly uncertain; and
- the relevant count of PMSE licences is any that have been active in the last year.

This implies α = 263 and therefore that a shared-use, on-site licence pays €263, while an exclusive use national channel pays €3,945 per 12.5 kHz channel.

7.3 PMSE fees

We suggest that PMSE fees should be half the level of a comparable PMR licence (typically a shared use, on-site licence). This is similar to the existing fee schedule for temporary business radio licences, with the discount reflecting that the licences are only temporary and do not receive protection. However, there are no strong grounds for pro-rating the PMSE fee based on licence duration, because the majority of the administrative burden to ComReg arises from processing the licence application, especially when the licences are issued on a non-protected basis.

Unlike other PMR licensees, PMSE operators use a wide range of bands, each catering for different types of equipment, with some using much wider bandwidths. Different types of equipment are complementary and bands relate to a type of equipment, the bands are not substitutes that an operator would switch between in response to price changes. There is no scarcity of PMSE channels in any of the bands and relationships between frequency bands in other contexts (where spectrum is scarce or bands are substitutable) do not apply to PMSE.

We recommend that ComReg identifies a typical bandwidth for each band and applies the per channel fee to a licence using that bandwidth. The constant per kHz charge would then apply to licences in the same band. For example, wireless cameras (operating in several bands from 2 GHz to 10 GHz) most commonly use 10 MHz channels, though a significant minority of licences use 20 MHz channels. In this case, a shared on-site 10 MHz channel for a wireless camera would pay a fee of $\alpha/2$, the same as a 12.5 kHz duplex PMSE channel in the UHF band, while a 20 MHz wireless camera would pay α (i.e. double the fee for the narrower channel in the same band).

We note that different frequency ranges are assigned to PMSE than other PMR licences even within the broader VHF and UHF bands – while it is our understanding that 12.5 kHz channels are currently the most common PMSE bandwidth in these bands, there is no reason that the typical bandwidths need to be aligned with other VHF/UHF PMR bands in the future. For example, the standard PMR UHF range is 450-470 MHz, whereas wireless microphone/IEM channels are available in the 470-490 range, with a maximum channel bandwidth of 200 kHz. If bandwidths typically required by PMSE operators increase, but those for other PMR use do not, the typical bandwidth in the 450-470 MHz range could be set to 200 kHz, such that a

200 kHz licence in that band pays the same as a 12.5 kHz PMR licence in the 450-470 MHz range, regardless of the fact that they are both in the broader UHF band.

As discussed in Section 5.1, we do not believe that costly additional measures to protect PMSE operators (i.e. additional on-site presence) are feasible or necessary and have assumed ComReg will not be significantly increasing its on-site monitoring off large events. If this is not the case, then the PMSE fee recommendation would have to be revised in order to recover the significant, PMSE specific administrative costs that ComReg would then incur.

7.4 Fee comparison

The median on-site business radio user, which uses 2x12.5 kHz channels, faces a modest fee increase from €198 on its existing licence to €263, while the largest fee changes under our proposals are to:

- business radio licensees with many pieces of equipment whose fees fall, as a direct consequence of removing per equipment charges;
- trunked radio licensees, whose fees fall; and
- third party business radio licensees, whose fees will increase if they continue to use national exclusive channels.

Current TPBR are roughly equal to trunked radio fee for a single base station and below business radio fees for licences with 45 pieces of equipment. This is not consistent with our principles of charging based on coverage and exclusivity, but being completely neutral to technology. When consolidating licence fees that were previously set with different structures and with uncoordinated levels it is inevitable that some changes will be necessary for certain users. Moreover, for national exclusive use licences, the TPBR fees appear rather inexpensive and are much lower than for shared use licences with much smaller geographic scope (i.e. trunked radio). In this case, it does not seem unreasonable that users of national exclusive use licences should face an increase in their fees relative to others with more restrictive licences. However, as noted above, current TPBR operators not requiring national coverage or that can operate under a shared use arrangement can mitigate the impact of the fee changes by adjusting their licences in accordance with their needs.

The graphs below compare the fees under our proposals to current fees in more detail, assuming TPBR licensees require exclusive use, but no other licensee does. Coverage areas are also uncertain and we assume they are a fixed radius (25 km for a wide-area licence) around a single point, but if all licences are non-national licences cover a small proportion of the country, fees are not particularly sensitive to our coverage area assumption. Following the consultation, ComReg may wish to recalculate these fees using the same methodology but more up-to-date licence data, but we do not expect this would cause large changes in the fee levels.

Figure 3: Comparison of old and new fees by licensee

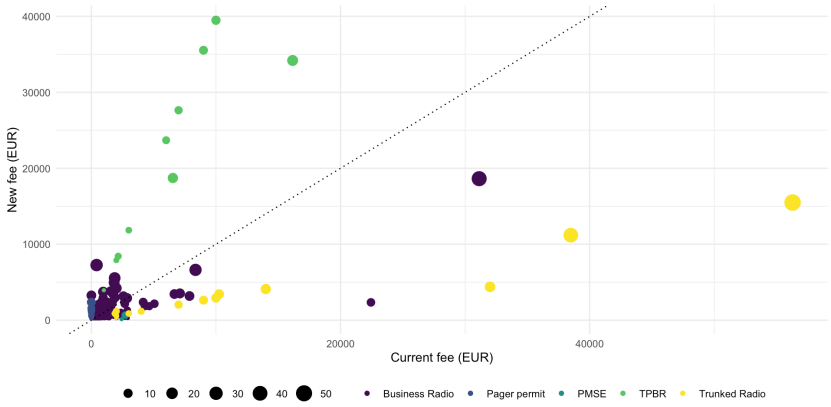


Figure 4: Median licence fees

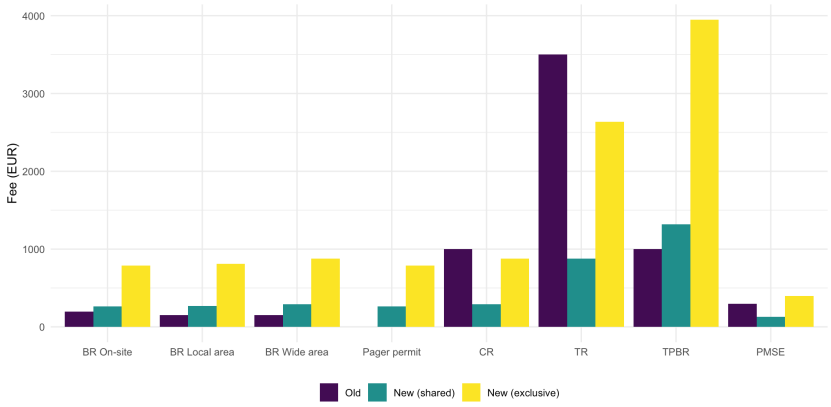
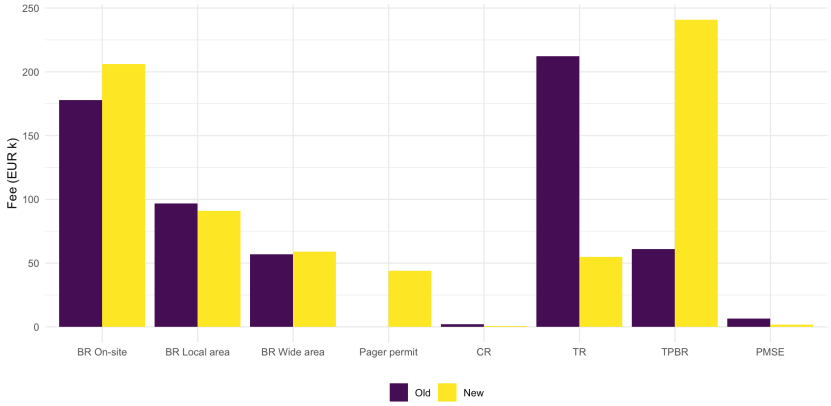


Figure 5: Total licence fees



Part 2: Wireless broadband low and medium power licences in the 3.8 – 4.2 GHz band

8 WBB LMP licensing

Recently European decisions have harmonised spectrum in the 3.8 – 4.2 GHz band for Wireless Broadband for Low and Medium Power (WBB LMP) networks. Use cases for this spectrum will likely include private 5G networks, providing capabilities not present in public mobile networks or fixed wireless access (FWA) networks. This band may also be used in deployments of 'neutral host' infrastructure within hospitals and similar mixed public/private spaces, providing both private 5G services and carrying public mobile networks into buildings.

The private 5G network market is still in the early stages. Expectations are that it will take off in the coming years as suitable spectrum becomes available and equipment using 5G connectivity becomes more common across manufacturing and logistics. There is a high degree of uncertainty about when this might happen, but it is likely that there could be rapid expansion once industries more widely adopt 5G connectivity into their everyday activities.

Therefore, while demand for the 3.8 – 4.2 GHz band for private 5G networks is only beginning to emerge now in Ireland and will likely be somewhat limited initially in the short-term, any licensing framework for releasing the band needs to be forward looking and robust to the possibility of rapid growth in demand. This includes the possibility of emerging congestion at some locations where there may be a high density of users, especially for outdoor applications.

The 3.8 – 4.2 GHz band is identified as being central to private 5G network developments in many sectors of macroeconomic significance, including advanced manufacturing transport and logistics. Therefore, a licensing framework that facilitates these productivity-enhancing investments in equipment and processes using private 5G networks could bring large benefits. To promote competition and encourage innovation, prompt access to this spectrum for WBB LMP deployments is needed. At the same time, reasonable long-term certainty is needed for users to support investments not just in network equipment, but also in plant and equipment using private 5G connectivity.

The remainder of this paper discusses aspects of any WBB LMP licensing framework in Ireland, and builds on:

- the harmonisation decisions and ongoing work in relation to this band, outlined in chapter 2 below;

- the stakeholder interviews carried out to understand the potential use cases, outlined in chapter 3; and
- Plum Consulting's analysis of the technical coexistence issues with the 3.8-4.2 GHz band as set out in ComReg Document 25/46b.

9 Regulatory background

9.1 Relevant CEPT/ECC/EC Harmonisations, Decisions and ongoing work

CEPT mandate

In June 2021, the RSPG recommended[15] an investigation into the possible use of the band 3.8-4.2 GHz for local vertical applications while protecting receiving satellite earth stations and other existing applications and services. Subsequently, the European Commission (EC) issued a mandate[16] to CEPT to study the technical feasibility of the shared use of the 3.8-4.2 GHz frequency band by low/medium power terrestrial wireless broadband systems (WBB LMP) providing local-area network connectivity.

Need for case-by-case interference analysis

CEPT conducted various studies on compatibility with and protection of in-band – including Fixed Satellite Services and Fixed Services – and adjacent band incumbent services, being WBB ECS (below 3800 MHz) and radio altimeters (above 4200 MHz). Its findings are presented in ECC Report 358 and ECC Report 362. Based on these, CEPT Report 88 provides the response to the EC mandate, proposing harmonised technical conditions, which include maximum in-block eirp limits for low and medium power base stations. The report notes that it has not been possible to define generic technical conditions that alone guarantee the protection of all incumbent services. Administrations are advised to conduct careful planning and case-by-case analysis, along with appropriate mitigation measures.

Harmonisation Decision

In November 2024, the ECC published Decision (24)01, setting out the harmonisation arrangement and the least restrictive technical conditions for the use of the 3.8-4.2 GHz frequency band. The Decision aims to facilitate deployment of terrestrial wireless broadband systems, on a shared access basis, providing local-area network connectivity and support the development

[15] Document RSPG21-024 final of 16 June 2021, RSPG opinion on additional spectrum needs and guidance on the fast rollout of future wireless broadband networks

[16] Document Ref. Ares(2021)7794710 of 16 December 2021, Mandate to CEPT on technical conditions regarding the shared use of the 3.8-4.2 GHz frequency band for terrestrial wireless broadband systems providing local-area network connectivity in the Union

of equipment available across CEPT countries in a common frequency band.

Local access only

The Decision sets out that WBB LMP networks should be used in a defined and limited geographical area and not a nationwide network. The CEPT administrations are required to designate the 3.8-4.2 GHz frequency band, or part of this band, on a non-exclusive basis for the use of low/medium power terrestrial wireless broadband systems providing local-area network connectivity, and the administrations shall ensure the protection of incumbent services in this band and adjacent frequency bands.

Both CEPT Report 88 and ECC Decision 24(01) noted that CEPT intends to develop recommendations providing guidelines for administrations to manage coordination between WBB LMP and incumbent services at national or local level, as well as cross-border coordination.

The CEPT project team FM60 is currently developing recommendations and guidelines to assist NRAs with the coordination of WBB LMP systems and the protection of other services in the 3.8 - 4.2 GHz band and adjacent bands.[17]

Status of EC Decision

In December 2024, the European Commission consulted with the EC Radio Spectrum Committee on a Draft Implementing Decision on the harmonisation of the 3.8-4.2 GHz frequency band. The draft EC Decision would establish the harmonised technical conditions for the availability and efficient use of the 3.8-4.2 GHz frequency band for WBB LMP systems, based on technical conditions set out in ECC Decision 24(01). In addition, , the draft EC Decision would mandate Member States to designate and make available on a non-exclusive basis the full 3.8-4.2 GHz frequency band for WBB LMP systems in compliance with the harmonised technical conditions by 30 September 2026. Since December 2024, the EC has continued to refine its draft EC Decision within the EC Radio Spectrum Committee, and a finalised EC Decision is expected to be adopted soon.

ComReg's RSMOP 2025-2028 plans

In 2024, ComReg consulted on its Radio Spectrum Management Operating Plan for 2025-2028 (RSMOP)[18], which included plans for the 3.8-4.2 GHz band for local-area WBB and private mobile (4G / 5G) networks. Respondents supported ComReg's proposal of putting in place a licensing regime for local-area WBB

[17] https://cept.org/ecc/groups/ecc/wg-fm/fm-60/client/introduction

[18] ComReg 24/65

systems, which could be used for private mobile (4G, 5G etc.) networks, citing reasons that private 5G networks are rapidly becoming a prerequisite to support a wide range of sectors, including manufacturing, transport and logistics, and entertainment and events. Respondents considered that networks provided by MNOs do not always best meet end customers' needs and, therefore, licences should be directly issued to the end users.

9.2 Approaches elsewhere

Spectrum licensing schemes enabling local area private mobile (4G/5G) networks are already available in some other countries, including in the UK, Germany, Norway and Belgium. Some of these licensing schemes were raised in the context of stakeholder interviews and examples of the key elements of these schemes are given below.

9.2.1 Bands

3-8-4.2 GHz deployment

Several countries made spectrum in the 3.8-4.2 GHz band available prior to the adoption of ECC Decision 24(01). In the UK, this band is available through the Shared Access Licence (SAL) regime. Poland released the band for private network deployments, reserving 3800-3900 MHz for local governments and 3900-4200 MHz for other entities, with up to 100 MHz allowed for each licence. Norway and Belgium have also made the band available for private networks, with Norway offering licences with 20, 40, 60 and 80 MHz bandwidths, and Belgium offering a maximum of 40 MHz bandwidth for each licence.

Private 5G in other bands

Since the deployment of the 3.8–4.2 GHz frequency band is still in its early stages, many existing private network licensing schemes in Europe utilise a different frequency band. This includes very similar spectrum in the band immediately below, assigned for MFCN in Ireland through the 3.6 GHz award. In Germany, the 3.7–3.8 GHz band is designated for private use. Sweden offers blocks in multiples of 10 MHz within the 3720–3800 MHz band for private networks. In the Netherlands, licensees may be assigned one or both of the 3400–3450 MHz and 3750–3800 MHz sub-bands. Switzerland has made the 3400–3500 MHz band available for private network deployments.

9.2.2 Licensee eligibility

International practice spans a wide range of possibilities for how the value chain of private 5G services is organised and who holds spectrum licences and takes responsibility for the private 5G network deployment.

Site management model

A 'site management model' for large sites or campuses was one of the suggestions raised during our stakeholder interviews. An example mentioned was the private 5G network at Harwell Science and Innovation Campus in the UK, provided and managed by Vodafone.[19] On this common managed network, tenants may have a customised network slice or priority access based on their needs.

Limited commercial deployment in Ireland

In Ireland, there has been some limited private mobile networks commercially deployed by the MNOs using spectrum licensed to them. In addition, a number of test or trial licences have been issued by ComReg for private 5G networks using spectrum in the 3.8-4.2 GHz band.[20]

CBRS in the US

In the US the Citizens Broadband Radio Service (CBRS) spectrum[21] is used for private 5G deployment on a non-protected, shared basis. While this is a very liberal regime, we heard from a large global manufacturer that these arrangements provide insufficient interference protection given needs for network reliability for advanced manufacturing applications. A particular concern was that MNOs could use the same spectrum for wide area coverage.

Site controller model

Some countries restrict eligibility for a licence at a particular site. For example, in Germany, applicants must prove they are, or are authorised by, the owner or tenant (with consent of owner) of the premise. This allows for various possibilities. The 'site controller' may be one and the same as the spectrum licence holder, network deployer and end user. However, more

[19] https://www.vodafone.com/news/technology/vodafone-to-install-5-g-standalone-mobile-private-network-at-uk-science-and-innovation-campus

[20] See www.testandtrial.ie

[21] The Citizens Broadband Radio Service (CBRS) operates under a three-tiered access framework: Tier 1 – Incumbent Access (authorised federal users, certain Fixed Satellite Service earth stations, and grandfathered wireless broadband licensees) receive protection from all other users; Tier 2 – Priority Access (10-year, county-auctioned licences of 10 MHz in the 3550–3650 MHz band, with protection from GAA users not from Incumbents); and Tier 3 – General Authorised Access (licensed by rule, opportunistic use of the full 3550–3700 MHz band, no interference protection).

commonly the site controller might hold a licence and be the end user, but outsource network deployment to a specialist. The site controller might also provide a common private 5G network (either itself or through outsourced deployment) to multiple end users (e.g. on a campus such as the Harwell example above).

The German model aims to avoid the potential for an end user to hold a licence at a location that it does not physically control and thereby prevent other users at that location from using that spectrum. However, it is far from clear whether this is necessary in many settings, as the owner (or tenant) of a site can in any case impose obligations on tenants (or subtenants) on the deployment of wireless services within the controlled geographical area. Such arrangements are already common in shared campuses.[22] As we discuss subsequently, there are also use cases such as transport (e.g. buses or trains) where there may be a need for deployment of a private 5G network within a public space, which does not fit neatly with the 'site controller' model.

9.2.3 Licence conditions

Licence duration

The duration of licences issued by other countries varies. In Belgium, Norway, France and Germany licences are granted for up to 10 years. In Switzerland, the licence duration is at least five years and depends on the investment. In Sweden, licences are valid for up to 5 years and until 31 December 2032 at the latest.

In some countries, the expiry of the private network licences aligns with the expiry of licences of other bands. In Germany, licences cannot run beyond 31 December 2040, so that a joint decision can be made on the use of the 3400-3800 MHz band from 2041 onwards. The Netherlands has also set the licence permits to be valid until 31 December 2040, which aligns the same expiry date for the national permits in 3450-3750 MHz. In Denmark, the licences expire without notice when the MNOs licence of the band expires, which is 31 January 2042.

[22] For example, in a multi-tenant campus with a shared Wi-Fi network there might be restrictions on deploying Wi-Fi access points within tenancy arrangements.

Bandwidth assigned

The bandwidth available for a single licensee varies across countries. Germany assigns bandwidth in multiples of 10 MHz, without explicitly stating a cap although the maximum bandwidth possible is 100 MHz. Countries such as the UK and the Netherlands cap bandwidths at 100 MHz, and Sweden caps bandwidth assigned at 80 MHz. Belgium assigns 40 MHz at most.

Licence revocation conditions

Most regulatory bodies reserve the right to revoke licences in the case of non-compliance with licence conditions, e.g. frequencies not used as stated in the application, frequencies not being used within a certain amount of time, or non-payment of fees.

For example, Sweden and the UK require use of spectrum within 6 months, Netherlands within nine months, Germany and Norway requires licensees to begin using their assigned frequencies within one year of the licence start date and Denmark allows up to two years.

10 Use cases

The 3.8-4.2 GHz band has been harmonised for low and medium power local area licensing. Use cases for this spectrum will likely come in the form of private 5G networks across a range of industries. In addition, the band may provide some limited enhancements or alternatives to existing public network infrastructure through the use of Fixed Wireless Access (FWA) and neutral host arrangements.

10.1 Defining characteristics

Private networks will be increasingly relevant to various industries and users who wish to deploy their own networks and are likely to be reliant on spectrum in the 3.8–4.2 GHz band. In Ireland access to this spectrum band has already been provided to some licensees for test and trial purposes using Test & Trial Ireland.[23] Without access to 3.8-4.2 GHz spectrum, it is likely that only the MNOs would be able to provide services for private networks. As noted earlier, there has been limited commercial deployment of private 5G networks in Ireland to date and this has been deployed using MNOs existing spectrum.

Requirements for bandwidth, latency, reliability and coverage vary greatly across potential users. Even within a given industry, there may be multiple uses varying in their requirements.

Therefore, we begin with identifying the defining characteristics of the private and public networks that are most relevant to WBB LMP licensing. We then move to a listing of use cases, organised according to these characteristics.

10.1.1 Current alternatives

Use of local area networks in the 3.8-4.2 GHz band offer advantages over currently available alternatives, such as traditional Wi-Fi, as well as presenting new opportunities for

[23] Test & Trial Ireland is a wireless licensing service provided by ComReg to encourage innovation and development of wireless communications in Ireland. It provides special licensing regimes for technology tests and service trials involving new radio technologies or services, allowing researchers and developers to test their ideas in a dedicated environment.

emerging technologies and uses. There is a distinction between those use cases that can be provided, even if at a lower quality, over available infrastructure and those proposed use cases that would likely require access to frequencies in the 3.8 – 4.2 GHz band.

Security and reliability

Some current users of Wi-Fi and fibre networks for on-site communications plan to migrate these services to private 5G networks. While the basic capabilities of these services will largely be the same, private 5G offers more control over the systems and enhanced security for the sensitive information often transported over these networks. Public mobile networks in particular can also get overwhelmed with traffic, so dedicated private networks are likely to be preferred or even required by some users, as users on dedicated spectrum may be less likely to encounter delays or congestion issues.

Latency guarantees

Whilst Wi-Fi can provide sufficient bandwidth for many applications, it does not have the latency guarantees that 5G can offer. For industrial control applications latency guarantees can be important to ensure that communications between sensors, control logic and actuators are quick enough.

Access Point handover

A significant limitation of Wi-Fi is that handover between Wi-Fi access points is governed by the behaviour of the Wi-Fi client, typically occurring only once signal strength from the currently connected access point degrades sufficiently. This handover behaviour can be unpredictable and it is not readily modifiable as handover policies are set within the client's hardware. In contrast, handover for 5G deployments is under the control of the network and can be configured to maintain good connectivity through handovers.

Some users may require dedicated spectrum to advance use cases not currently feasible over existing infrastructure. Several of the proposed use cases, notably those in industrial settings, require the ultra-low latency that only 5G private networks using dedicated spectrum can provide. In these applications, quick and constant communication is critical to the site's operation, and existing alternatives like Wi-Fi are not advanced enough to safely operate the technology. Other users propose the use of private 5G networks to facilitate data collection, analysis and decision making entirely on-site.

PMSE use

With 5G's connectivity capacity and the service quality guarantees that 5G can offer, programme makers have expressed interest in replacing their use of long cable runs and

traditional PMR/PMSE equipment and spectrum with local area private 5G networks[24].

Network slices on public networks

Network slicing on public mobile networks can theoretically offer an alternative to private 5G networks for some emerging uses, noting however that to date there has been limited or no MNO provision of such services in Ireland. In these cases, users would negotiate access to a dedicated portion of MNO spectrum, likely in the 3.6 GHz band, at their site. While this is a potentially viable alternative, private 5G networks built by or for the end customer using dedicated spectrum can be more attractive to users who want full control and flexibility over their networks.[25]

There is also the possibility of using higher frequency bands, such as the 26 GHz and 40 GHz frequency bands for 5G networks. However, there is currently no material demand for this spectrum for 5G purposes[26], and consequently there are no plans to put in place a WBB licensing framework in these bands at this time.

10.1.2 Bandwidth needs

The stakeholder engagement exercise has highlighted a likely diverse range of bandwidth requirements across potential users. We have heard that 5 MHz is the minimum usable bandwidth, but some users have said that they would require up to around 100 MHz, or even more.

Bandwidth by use

Several of the more traditional/basic communications applications for this spectrum (i.e. voice and messaging services) can be accommodated using limited bandwidth. However, some applications, especially those involving video transmission, would likely require higher bandwidths. This includes, for example, CCTV systems, visual pattern recognition, augmented/virtual reality applications, remote control of

[24] See for example the respondents' views submitted to ComReg's Radio Spectrum Management Operating Plan for the period 2025-2025 as summarised in paragraph 2.30 of ComReg Document 24/99.

[25] See also the respondents' views submitted to ComReg's Radio Spectrum Management Operating Plan for the period 2025-2028 as summarised in paragraphs 2.31 to 2.32 of ComReg Document 24/99.

[26] See ComReg's consideration of the 26 GHz band in Section 2.2 of its Response to Consultation on its Radio Spectrum Management Operating Plan for the period 2025-2028 (ComReg Document 24/99).

machinery if video feedback is required, safety cameras and programme making.

Dual networks

We have also heard from stakeholders that a small number of users with very high reliability requirements would also likely want to build in redundancy by deploying two parallel networks. This potentially doubles the bandwidth needed in a licence compared to the day-to-day operational requirements.

Multi-tenant networks

Although not strictly related to a use case, another potential scenario that has been raised by stakeholders is where a licensee takes on control over the operation and management of spectrum on a particular site with multiple users. This may require access to larger amounts of spectrum for that model to operate effectively in order for the bandwidth requirements of multiple users to be met.

10.1.3 Site characteristics

We expect that private 5G networks would be adopted across a wide range of sites with differing radio frequency environments. These distinctions will likely impact the way these networks are designed, the capabilities provided and the likelihood of the site interfering with other users. Important characteristics include:

- **Coverage area:** As stated in the draft implementation decision, this spectrum is to be made available for local area use. Still, the extent of "local area" will differ by use case. We expect many private 5G networks and neutral host settings to be contained sites with clear boundaries. FWA uses, on the other hand, may require a broader (although still "local") coverage area.
- **Geography:** Some use cases are likely to be in geographically isolated areas (e.g. energy sites) while others are likely to pass through denser areas (e.g. transport applications). There are also proposed use cases, such as office parks, ports and retail centres, that may involve a cluster of multiple users at one site.
- **Indoor/outdoor use:** Likely uses for this spectrum include both indoor and outdoor sites. This site characteristic impacts the user's ability to control out of area emissions and therefore coordinate its use with neighbours. Outdoor use cases would likely have extra considerations in their network design.

10.1.4 TDD profiles

Some use cases might rely asymmetrically on upload or download capabilities and therefore TDD profiles may vary considerably across networks. Our expectation is that a typical private network will be more heavily weighted towards uplink capacity than public mobile networks, with applications like CCTV being particularly uplink heavy.

Synchronisation of TDD frames is possible for many users, because minor adjustments around their ideal uplink/downlink ratio are possible without operational consequence. However, synchronisation may be infeasible if one network is uplink heavy and a neighbouring network is downlink heavy and this difference is large.

10.1.5 Integration with public services

Potential users of the 3.8-4.2 GHz spectrum will seek out varying degrees of integration with services using other bands, especially services provided by MNOs. Many of the proposed use cases (hospitals, universities, etc) will be at locations with significant public use of mobile services, but with in-building coverage or capacity challenges. The use of private 5G networks can avoid private services (e.g. hospital staff usage) having to use public networks where coverage or capacity might be limited. However, in many of these cases, the user might also want good public mobile coverage within its site. For example, a hospital might also want public mobile services in-building for visitors and patients alongside its private 5G network.

In these cases, a potential solution might be a neutral host network, where a common RF infrastructure is provided throughout the site that can carry both a private 5G network and an RF layer for public mobile services. Commercial agreements could then allow mobile operators to interface with that common infrastructure at a handover point.

10.2 Private 5G Networks

Private 5G networks are expected to become integral to operations in a wide range of industries, with strong potential uses in industry, agriculture, energy, events, transportation and a variety of large campus settings. These sectors prioritise

security, reliability and control when it comes to their connectivity.

Use of private 5G is linked not just to investment in private network infrastructure, but also potentially to investments in equipment and plant that may require such connectivity over their entire operating life. Users are likely to require regulatory certainty over a long-time horizon as sustained access to private 5G connectivity may be a requirement for moving to applications such as advanced manufacturing floors. Therefore, the question of regulatory certainty is especially important and much broader than just providing opportunity for recovery of network investment costs.

10.2.1 Use cases

Private 5G networks have many uses including:

- Voice and messaging comms, including push to talk
- CCTV
- Emergency alarm systems
- Sensing and monitoring
- Tracking
- Internet of Things
- Automated guided vehicles within industrial and manufacturing areas
- Remote control operation of equipment
- Augmented Reality (AR)/Virtual Reality (VR)
- Artificial Intelligence
- Pattern recognition
- Content production
- Backup networks

This list is non-exhaustive, and the list of uses would be expected to expand over the lifetime of this framework as private 5G is a relatively new technology. Many users will employ private 5G in multiple ways. A large factory, for example, might utilise many of the specific uses listed above, such as telematics for factory floor equipment and to operate mobile terminals for staff.

As noted above, the use of some private 5G networks may be a migration of existing services for improved quality and reliability, while others entail entirely new applications. The bandwidth and other technical needs of these uses vary greatly, as discussed above.

The key drivers for private 5G networks are the need for highly reliable, low latency and secure connectivity, often for use in critical operations for the user. These factors are common across many industries. These deployments may require substantial upfront investment and, as it is new technology, may also feature long development timelines. The resulting framework should aim to accommodate use cases featuring all of these characteristics.

10.2.2 Industrial applications

Manufacturing

The manufacturing industry is undergoing rapid technological advancement as IoT and other "smart factory" technologies show how near-instantaneous, automated communication can make factories safer and more efficient. Modern factory floors use automated guided vehicles (AGVs), CCTV systems, augmented and virtual reality programs for training and development, sensors to monitor quality and safety, and automatic labelling. While some of these uses can be operated using current Wi-Fi or cellular options, private networks in the 3.8-4.2 GHz band present the opportunity for lower-latency services and highly controlled data environments.

Logistics and distribution

Manufacturing use cases often must be integrated with the logistics and distribution side of industry. Item tracking and AGVs are essential to operations at warehouses and distribution centres. To maintain connectivity while out for distribution private 5G networks may need to be integrated (potentially at the application layer) with public mobile networks.

Ports

Ports require advanced communications systems to monitor entry and exit, track and position vessels, operate automated guided vehicles (AGV), implement visual pattern recognition, run safety and security systems across the site (including CCTV systems) and several other essential use cases. Many of these uses are high-bandwidth applications. These systems may also require further integration with elements of logistics and transportation systems.

Airports

Airports have many of the same needs as ports, listed above. Additionally, private networks can be employed to make passenger security, baggage delivery, and parking systems more reliable and efficient. It has also been proposed that video systems over private cellular networks, likely using the 3.8-4.2 GHz band, may be used for air traffic control. Airports also require significant integration with public networks, facilitating

the use of cellular services at an expansive site for thousands of passengers at a time.

Ports and airports are increasingly looking to private networks for providing these services, as the networks can be flexible and adaptive to changing needs. Dedicated, private networks offer more security and control over the data and radio environment.

10.2.3 Applications in energy, natural resources and farming

Mines, energy sites and large farms present ample potential and realised use cases for private networks. These sites are commonly very large and geographically isolated, complicating the use of traditional communications technology. This, along with advancing technologies in these fields (IoT, real-time data collection and modelling, predictive maintenance, etc) and extensive security concerns, make private networks operating in the 3.8-4.2 GHz band attractive in these sectors.

Energy generation and distribution

Energy sites, both on-shore and off-shore, and their distribution grids, are critical infrastructure requiring continuous monitoring, operation and maintenance, all of which could be effectively provided using a private 5G network. Internationally, private 5G networks are used by energy providers for the quick identification and rectification of faults, smart grid integration, remote control of equipment (e.g. steering solar panels) and continuous monitoring of output. When integrated with wider information systems, these networks can optimise the distribution of energy. These systems can also provide enhanced safety measures for workers at these sites, hosting push-to-talk communications, body cameras and emergency alarm systems.

Agriculture

Smart agriculture is a rapidly developing field that uses digital connectivity to improve farming techniques. IoT systems feature a large number of small devices monitoring and sending readings back to a main control point. Private cellular networks are an efficient choice for these systems, as they facilitate the use of small, low-power devices with long battery lives. Agricultural operations can then be refined based on input data that is continually received. With a private 5G network, advanced data analysis and modelling of these readings can be executed on the same network, on-site.

Mining

Like energy sites and farms, mines and tunnel projects are geographically isolated and often found in RF-unfriendly environments. Mining and tunnelling operations have the additional challenges of establishing communications in subterranean environments and implementing operations with exceptional safety concerns, which often require seamless connectivity. Key uses include remote control operation of drilling equipment and environmental sensors. Private 5G is an exciting option for providing these needs, as it offers extremely low latency and a high degree of reliability.

10.2.4 Campus settings

Private 5G networks can supplement the every-day communications needs either exclusively for staff or also for the public/patients/customers etc when integrated with public mobile networks. This includes their use at hospitals, universities, schools, retail centres and company campuses.

Currently, private 5G networks in these settings are primarily proposed as a more secure, reliable alternative to Wi-Fi and public cellular, for which to migrate existing campus-wide communications. They may additionally have advanced equipment deployed on the same network, e.g. hospitals might replace paging with voice/text communication between staff over a private network, and may also use patient monitoring equipment on the same network. There may be some interest in staff being able to use the same device/SIM off-campus, either on private networks or with a complementary public network connection.

Dedicated research and development sites are a subset of this category. These sites, which may also have the traditional communications use cases described above, specialise in providing private 5G systems for research and testing of emerging technologies. These sites have more specific technical requirements and often cater to uses and technologies that would not be possible or as efficient on alternatives like Wi-Fi or fibre.

Campus uses may also involve multi-tenanted networks, where a site controller provides a single network infrastructure providing connectivity to multiple end users. Network slicing can be used to provide dedicated bandwidth and latency guarantees even with networks being shared. Bandwidth

requirements may be more considerable in these shared network situations.

10.2.5 Events and programme making applications

Private 5G networks have been proposed, and in some places implemented, as an alternative to traditional Program Making and Special Events (PMSE) systems at large events. Sports, concerts, conferences and other large cultural events. Such events use a broad variety of equipment to produce and broadcast the content, requiring push-to-talk communications, microphones, and cameras. This applies to permanent systems in place for arenas and the like, as well as temporary systems for events, such as music festivals, where operators bring their equipment on-site for a limited time period.

10.2.6 Transport applications

Private 5G networks can be used on transport networks for communication between staff, CCTV monitoring or remote tracking or command and control applications. In some cases, transport applications will overlap with campus or industrial applications, particularly on large sites (e.g. train depots or ports) within transport networks, but they can also be deployed more widely. There is a particular case for this on train or metro routes, which cover set, predictable routes, giving scope for additional uses such as automated trains. Underground trains are in isolated interference environments, while other transport applications might cover a smaller total area, but along lines (i.e. tracks) that often pass other potential private 5G users at specific points.

Transport infrastructure development is often a major project with long lead times between initial design phase, which increasingly will include specification of private network requirements, and becoming operational. Therefore, these users may require certainty on spectrum availability some time before it is envisaged to be put to use. This would need to be considered if imposing rollout obligations on such a licensee.

10.3 Public networks

10.3.1 FWA

It is possible that Fixed wireless access (FWA) providers could use a WBB LMP licence in the band to provide broadband access to households or business at fixed locations. Such deployments would typically be medium power outdoor deployments.

The 3.8-4.2 GHz band is used for FWA in other countries, including in the UK, while the neighbouring 3.6 GHz band is used in part for FWA both in Ireland and internationally.

In Ireland we would not expect FWA to be a common use case in this band, largely because of the extensive availability of fibre, including in rural areas under the NBP,[27] and because FWA operators have access to other licence-exempt and licensed spectrum (e.g. through fixed links and FWALA licensing) and have had opportunities to gain access to spectrum in other bands, such as by participating in the 3.6 GHz award. Furthermore, it is unlikely (due to scale economies) that there would be more than one FWA network covering the same area (particularly as service areas are likely to be rural), or that any one network would require a large bandwidth relative to private networks (e.g. Imagine won 60 MHz in the 3.6 GHz award, but has since moved to using NBI fibre to provide higher speeds[28]).

10.3.2 Neutral host

Neutral hosts install and manage telecoms infrastructure that is then made available to third parties for provision of their services, e.g. for all three MNOs to extend coverage or capacity to an area where it is not feasible for each of them to individually deploy their own network equipment, which could be because of cost (in remote areas) or a lack of space for installing equipment (in built environments). Neutral host services do not always require their own spectrum, if instead they are providing passive infrastructure, or active radio

[27] https://nbi.ie/where-can-i-buy/

[28] https://www.imagine.ie/imagine-agrees-new-network-deal-with-national-broadband-ireland/

equipment but with third party service providers ultimately using their own spectrum.

Access to spectrum in the 3.8-4.2 GHz band can be useful to neutral host networks, e.g. to provide capacity, allow truly neutral access including to service providers without appropriate spectrum, or to simplify network set up. Neutral hosts might operate across many of the sectors and some of the use cases discussed in relation to private networks, but for the purpose of allowing multiple end users to access the spectrum.

11 WBB LMP licence framework

This chapter discusses key aspects of a WBB LMP licensing framework for Ireland, including licensing conditions and application process. The proposed licensing framework will need to establish licensed deployment/coverage areas, licence duration, rollout requirements and other licence conditions.

In determining these provisions, ComReg will need to consider how best to provide regulatory certainty to users, especially those with significant investment costs over a long time period, while also establishing a licensing framework designed to ensure that spectrum is distributed and used efficiently, both initially and in the future as demand develops, and that valid use cases are not unintentionally prohibited (neutrality).

Fundamental to any recommendations regarding the licensing framework is our understanding that, as this is a new framework likely to be used by emerging technologies, the use and demand for these licences might change considerably in the coming years. Initial uptake might be limited and congestion unlikely to arise in the near term, especially if all 400 MHz within the band is made available and the licensing rules create reasonable incentives and requirements to avoid licensing more spectrum than needed. However, it is possible that use of the band could escalate rapidly as industrial, manufacturing and other uses migrate to 5G connectivity.

We cannot predict the scale and timing of any such future surge in usage but is prudent to plan for this scenario when designing the licensing regime. In particular, the licensing framework should avoid the need to make subsequent changes to the licensing regime to accommodate developments (such as potential conflicts between users for spectrum when concentrated at a locality). There is also the potential for significant demands to be placed on ComReg's resources from an expansion in usage that led to more local conflicts between users that needed resolution.

The discussion builds on:

- the harmonisation decisions and ongoing work in relation to this band;
- the stakeholder interviews carried out to understand the potential use cases for this band; and

- Plum's Consulting's analysis of the technical coexistence issues with the 3.8-4.2 GHz band as set out in ComReg Document 25/46b.

11.1 Geographic scope of licences

There are various licensing options available in relation to the local geographic scope of a licence. National coverage would not be allowed.

In a parallel study, Plum Consulting has considered the potential approaches to defining the geographic scope of WBB LMP licences, taking into account approaches elsewhere. The output from Plum's findings suggests three broad options:

1. For low power licences, a licence would allow for the flexible deployment of multiple base stations within a circle with a 50m radius around a fixed point (noting that the area covered by the network service – the 'service area' - may extend beyond the limits of the circle.
2. Medium power licences would be for a single base station, where the geographic scope is defined by the characteristics of the base station (and any technical restrictions imposed by ComReg).
3. User defined coverage areas, where the geographic scope of a licence would be set by the user which would then be allowed to deploy its network (potentially with multiple base stations) flexibly within that area, provided licence conditions are met.

The individual licensing of base stations for medium power, and the use of a 50m radius circle for base station deployment (i.e. options 1 and 2 above) are licensing approaches in use elsewhere (for example in Norway and the UK). These options are likely to be sufficient to meet most user needs. They also offer the benefit of being relatively simple to understand and implement for both licensees and ComReg.

However, some users may prefer a user-defined licensed area. Relative to licensing individual base stations, user defined areas could have the benefits of:

- giving licensees the freedom to design and adjust their networks in a way that would best serve their usage requirements within the area (provided that any maximum field strength level requirements continue to be met and

ComReg is informed of any changes that require a licence amendment); and

- allowing for licence borders to be more precisely defined, with a sophisticated RF setup with directional antennas being used to allow for a smaller coverage area than if the geographic scope was based simply on the positioning of base stations. If successful this could support efficient use of the spectrum in cases where users do not have to take out a licence that covers areas they do not need,

Plum notes that establishing appropriate field strength values to define a service area might prove disproportionately complex for the majority of applications and certainly for the low-power case. In addition, Plum notes that defining appropriate field strength values would require assumptions about the technical characteristics of the (unknown) services to be protected which may lead to inefficient planning and raises questions over the practicality of this option at this stage.

11.2 Licence duration

In many of its established spectrum licensing frameworks (e.g. for fixed links and satellite Earth stations) ComReg issues annually renewable licences and licensees make multi-year investments under the expectation of long-term access to these licences. Each year, prior to the expiry of its current licence, a licensee would submit a renewal application for a new licence, and the renewal licence is generally issued with the same terms and conditions as its current licence. Therefore, long duration licences are not necessarily needed to support long-term investments provided there is sufficient certainty of licence renewal and there is confidence that the licensing framework will stay in place.

While ComReg retains the right to amend or revoke one-year licences in objectively justified cases, this seldom occurs and is generally limited to specific situations. For example, where licensees are not compliant with the terms of their licence or if migration of spectrum users from the band is necessary to comply with international harmonisation measures assigning the band to a new use.

Changes to international harmonisation measures are typically infrequent events and generally signalled sufficiently in advance to allow users a reasonable period of time to adjust. Moreover, given the EC process of harmonising the 3.8 – 4.2 GHz band is

currently in process (i.e. at the beginning of the period in which the band would be harmonised for WBB LMP), some additional regulatory certainty should come from the reasonable expectation of availability of the band for the foreseeable future.

Reasonable confidence over long-term access to spectrum is a point that has come up frequently in stakeholder interviews, with stakeholders expressing a view that short-term licences will hinder private 5G development in Ireland. Some of the 5G private network use cases in the 3.8-4.2 GHz band may require large investments in long-lived manufacturing equipment, industrial plant and other infrastructure, which potentially bring large macroeconomic benefits. These users are likely to require regulatory predictability over access to the band over the operating life of their network.

Some potential investors may nevertheless have concerns that the implementation of one-year licences with annual renewal does not provide sufficient certainty. They might be concerned that the regulator would have powers to revoke or not issue a renewal licence even if, in practice, that would very seldomly happen and would generally be limited to objectively justified specific situations.

However, there are also concerns over the issuing of long-term licences that need to be balanced with provision of investment certainty. The private 5G network industry, and other potential uses of 3.8 - 4.2 GHz spectrum, is currently undeveloped (with future demand unclear), and the technical implications of deploying WBB LMP networks within the band are still being considered by the relevant technical harmonisation bodies, particularly the CEPT FM60 work group. Applying a degree of caution to the design of the licensing framework at this stage is warranted. Locking in spectrum assignments for a significant period of time through long-term licences would appear inappropriate and may leave limited scope for ComReg to make any necessary adjustments as usage evolves.

A balance needs to be struck between providing appropriate long-term certainty for users and protecting against inefficient assignment of spectrum if licensees apply for more than they need or without a clear use for the spectrum, preventing access to other potential users. This will require consultation with stakeholders, but as a starting point such a balance might be struck through:

- a WBB LMP licensing framework which provides regulatory predictability noting that some licensees may require long periods of time to make a return on investment;
- notice of any major changes to the licensing framework being provided in sufficient time, and consulted upon where appropriate;
- the provision of annual licences, with renewal licences subject to payment of spectrum fees and compliance with licence conditions, thereby providing a high degree of certainty of renewal; and
- a rollout obligation being required for all licences.

A rollout obligation balances the implicit rights that a licensee would have to renew a licence. We discuss spectrum fees in the subsequent section, but for now we note that, absent a roll out obligation, fees are unlikely to be an adequate disincentive for users licensing more spectrum than they need. This is because spectrum scarcity is likely highly localised and fees cannot readily be structured to reflect opportunity costs in all cases.

While annually renewable licences would suffice for the most common use cases in the band, stakeholders have also expressed an interest in shorter term licences, particularly for PMSE applications that are only at a site for a limited period of time. For this purpose, we suggest that ComReg might consider whether the PMSE licensing framework could be modified to offer temporary PMSE licences in the 3.8 – 4.2 GHz band for durations up to six months, although some licences might be much shorter e.g. running for a few days around a music festival.

11.3 Rollout conditions

To protect against inefficient allocation of spectrum that would arise if licensees applied for more spectrum than they needed or without a clear use for the spectrum, thereby preventing access to other potential users, the use of rollout conditions should be considered in the WBB LMP framework.

For base station rollout, this could require the licence holders to have deployed one or more base stations using all of the licensed frequencies within a defined period (e.g. 6 months). ComReg might also consider a similar rollout condition in relation to user equipment, for example to ensure that user equipment would be put into use.

Where rollout requirements, or any other licence condition, is not met, ComReg's licence compliance actions could lead to ComReg not renewing the licence or changing its terms and conditions.

The rollout condition should allow enough time for project development. Our initial proposal is that, by default, usage of the spectrum should be required within 6 months of first receiving the licence, and there could be merit in considering additional rollout obligations for licence applications with more impact on potential neighbouring users (i.e. medium power outside uses rather than indoor uses).

However, it should also be recognised that some exceptional private network deployments might have a significantly longer roll out period (e.g. a large overall development project, such as a new transport system). ComReg could, at its discretion, consider whether longer rollout periods might be justified in those cases. This would likely require sufficient evidence, including deployment plans, to be provided to ComReg over intent/ability to use the spectrum (within a reasonable timeframe) and why an exception might be warranted.

11.4 Application requirements and obligations

In the WBB LMP licensing framework, spectrum should be made available in a manner that ensures the efficient use of spectrum and on terms that encourage investment while protecting the availability of spectrum for future users where possible.

Ideally the licensing framework should:

- minimise opportunities/incentives for licensees to take more than they need, in particular in terms of bandwidth, but not unnecessarily prohibit licensees where needs are justified and reasonable;
- ensure sufficient obligations are in place to mitigate the risks of congestion and potential new users being unreasonably precluded from having access to spectrum; and
- minimise the administrative burden on ComReg and licensees where possible.

As highlighted in Section 12 below, there is limited scope for relying on fees to generate the required incentives for operators

to act efficiently when applying for licences. In addition, the efficient licensing of users is likely to require case-by-case assessment that cannot be dealt with through generic licence conditions. We therefore expect that the application and licence renewal processes (along with other obligations such as rollout) will play an important role in supporting efficient use of the spectrum and managing interference between users. This would likely have resource implications for ComReg in administering this process.

Application information

To provide ComReg with sufficient information to conduct an assessment of a licence application, monitor usage of the spectrum, and provide sufficient information to other (current or potential licensees) on existing allocations, we would recommend ComReg to require a standard minimum amount of information to be included in new applications. This may include:

- base station details (location, power, antenna, etc.), synchronisation profile and requested geographic service area, including whether it is to be used indoor or outdoor;
- justification for the coverage area, medium power (if requested) and bandwidth requested needs to be provided to ComReg on application – for medium power and/or larger bandwidths and coverage areas, applicants should expect to need to submit more comprehensive justification for a licence to be granted; and
- information on the planned service, rollout and traffic usage (which could be used to inform any additional rollout conditions beyond the standard 6 months obligation and/or ComReg's assessment of the coverage/power/ bandwidth requested).

In addition, we would advise ComReg to reserve the right to request further details on a case-by-case basis.

Similar information would be required on subsequent annual licence renewals, although there could be merit in varying the ongoing reporting obligations imposed on different users.

Certain users (e.g. with low power indoor networks, or in geographically isolated locations) create limited risk of interference or congestion, have little impact on others, and might therefore require minimal interaction with ComReg. Arguably there is little to be gained from requiring more information from these users on licence renewal other than the bare minimum needed to keep ComReg's licensing records up to date (e.g. base station details).

Where users are more likely to create interference or restrict access to spectrum for others (e.g. with outdoor use, medium power networks, large bandwidth requirements), the collection of additional information would support ComReg in monitoring usage more closely and potentially take actions to revoke/adjust licences should licence conditions not be met. Having variable obligations may also create some incentives for users to not apply for more than they need (to avoid the subsequent administrative burden).

Coordination obligations

For all licences, licensees should justify their bandwidth needs and their use of the spectrum on application and on each subsequent licence renewal. In most areas, at least in the short run, there is likely to be ample spectrum available, particularly where the application process requires users to consider carefully (and justify) their requirements.

However, new operators arrive sequentially and there may come a point at which accommodating a new operator can only be achieved through coordination with existing licensee(s). The coordination process is likely to work best if operators are allowed to negotiate and come to a solution amongst themselves.

11.5 Information available to users

It is likely to be beneficial for stakeholders (licensees and potential users) to have ready access to information about current licences/usages, ideally via an online platform (as in the UK). This would help users in their applications, coordination and assist with network planning.

We note that in Document 24/90,[29] ComReg made the decision to publish radio spectrum information regarding fixed radio link licences and satellite earth station licences to comply with the relevant requirements within the Access to Information on the Environment Regulations 2007. ComReg also stated its intention to publish radio spectrum information for other licence types in the future. We understand that the information will be published in due course on ComReg's Siteviewer tool. Therefore, we anticipate that future WBB LMP licence information will also be made available by ComReg, however, there would be some ongoing associated cost to ComReg

[29] ComReg Document 24/90 - Publication of Radio Spectrum Licence Information – published 14 November 2024

arising from updating the Siteviewer tool to include additional licence types.

12 Fees

12.1 Fee structure objectives

Regulation 24 of S.I. No. 444 of 2022 permits ComReg to impose fees for rights of use that reflect the need to ensure the optimal use of the radio frequency spectrum. As the WBB LMP licensing framework would be entirely new, the fee structure would need to be built from the ground up. The optimal use of the radio spectrum in the case of WBB LMP can be best achieved through consideration of the following factors:

- **Administrative cost recovery:** Revenues collected from the licensing scheme should cover the costs to ComReg associated with the framework.
- **Incentives for efficient use:** The framework should encourage the efficient assignment and use of 3.8-4.2 MHz spectrum and encourage licensees not to take more than they need to operate. Financial incentives should align with these goals and could apply to the amount of bandwidth, the coverage area, power levels, base stations to be deployed and indoor/outdoor usage[30].
- **Avoiding barriers to take-up:** The potential use cases for this spectrum are varied. The fee structure, while maintaining the incentives outlined above, should not discourage take-up by atypical projects.
- **Transparency and consistency:** Clarity and certainty of fees is important to users who rely on these licences and essential to attracting investment in emerging technologies needing long-term investments.
- **Practicality:** The fee structure must be feasible for ComReg to implement and maintain.

This section expands upon each of these objectives in turn. However, note that there is inevitably some conflict between them. If fees are set to recover administrative costs, but otherwise kept to the minimum to encourage take-up, this may not assist in providing sufficient incentives to economise on bandwidth/coverage area and noting that this objective would also be promoted with other licensing rules (e.g. the application

[30] Plum's report presents indicative re-use distances for various potential interference paths, and indicates that this distance varies depending on power, indoor/outdoor usage and synchronisation.

process and roll-out obligations). Also, we must acknowledge that there is a high degree of uncertainty, and likely much heterogeneity, in how much users will value access to this spectrum depending on what alternatives they have.

Administrative cost recovery

A key point in applying these objectives is the assumption, developed through desk research and stakeholder interviews, that Ireland is unlikely to see scarcity of this spectrum in the short term. The local nature of these licences means that many users can benefit from using the same spectrum across the country, and the initial levels of demand are likely to limit the scope for scarcity issues to arise. Without scarcity, there should be no need to apply any opportunity cost-based fee structure, and instead the level of fees could be set primarily to recover ComReg's administrative costs efficiently across different user groups while also incentivising the efficient use of spectrum.

In this scenario, the total revenues from this licensing scheme would need to meet or exceed ComReg's administrative costs to keep the risk of under recovery to acceptable levels. Estimating these revenues, however, is difficult when there is substantial uncertainty over take-up. As the licensing scheme is entirely new, there is significant uncertainty over relevant factors including:

- the expected number of licence applications (which may change significantly over time);
- the bandwidth that users will require; and,
- the coverage areas that will be requested.

This uncertainty leads to a substantial risk of under recovery of administrative fees. Covering administrative costs ensures that the licensing scheme is stable and sustainable, so for fee setting purposes it would be prudent for ComReg to use conservative assumptions about take-up.

Additionally, administrative costs for this framework could change over its lifetime. There are likely to be upfront costs related to implementation and setting up the necessary checks which will need to be recovered over the lifetime of the framework. Operating costs related to interreference checks and separation distance calculations will also likely rise as the number of licensees rises, particularly if uptake reaches a point at which ComReg might receive several applications for networks in a relatively small area.

Future proofing against potential scarcity

While there is no evidence of scarcity at this point in time, and thus that is not a key consideration in the fee formulation, the framework should be robust against any scarcity that might

arise in the future. There could be potential for scarcity to arise when uptake increases, particularly in urban areas such as Dublin or in densely developed industrial areas. In the case of future scarcity, the framework would primarily rely on the application process, licence conditions (e.g. rollout) and compliance checks by ComReg (see Section 5) to ensure that the spectrum is used efficiently and resolve issues. In addition, information on existing licences would be available to encourage applicants to consider incumbent sites and spectrum availability when choosing where to locate their sites. If scarcity arises anyway in particular areas, there are tools available to ComReg to incentivise efficient use, including the potential to add a congestion surcharge to the fee structure, as used previously in other licensing regime such as fixed links.

Incentive structure

There is limited scope to create these incentives solely through the fee structure, as the fees might not vary enough to exert influence over behaviour. Such incentives would also need to be encouraged through other aspects of the licensing framework. Nevertheless, the fee structure should support key objectives, and it would be helpful to build some incentive measures into the fees.

Efficient assignment of spectrum relies on users taking only the bandwidth and coverage area that they need to operate and that they can put spectrum into use within a reasonable timeline. These principles feature throughout our considerations for the framework, notably in the justifications necessary upon application and the potential for attaching obligations to licences. The fees may therefore be set to vary in accordance with parameters such as:

- bandwidth;
- coverage area; [31]
- indoor/outdoor use; and
- power level.

Applicants should be encouraged to take the minimum bandwidth needed to run their operations, and thus higher bandwidth projects should incur higher annual fees. The same is true for coverage area, which could be measured by a small deployment area in the case of low power, by base station in the case of medium power, or by user-defined coverage areas.

[31] An approach to fees would need to consider the three broad options to defining the geographic scope of a licence as set out in Section 4.1.

Other potential parameters (indoor/outdoor use, power level) relate to the risk of creating interference on their neighbours. Indoor, low power and synchronised-use all minimise the risk that a network will create harmful interference to neighbours and minimise the necessary separation distance between users. The pricing formula could be used to financially incentivise efficient use through these characteristics.

Avoiding exceptionally high fees

The extent to which the variable parameters included in the determination of fees increase the annual fee should be significant enough to create effectual incentives to operate efficiently (e.g. minimise bandwidth and coverage area, operate at low power when medium power is not needed), but not so high as to inefficiently price off certain applications, or to result in exceptionally high fees at the upper bounds of these parameters. For a balanced approach, ComReg could implement a fee structure composed of a fixed term plus a variable term. Under this structure, doubling the bandwidth (or area) used, for example, would result in a sizeable increase in, but not quite doubling of, the annual fee.

Transparency, and consistency

Many of the proposed use cases and technologies for this spectrum require significant investment over a long time. Transparent, consistent fees, and reliable spectrum availability, facilitate the necessary investment to make these business cases work. Certainty over future licensing will encourage innovation in the field.

Practical implementation

Finally, the framework must be realistic to implement and not overly onerous on ComReg to maintain. The objectives outlined above are meaningless if the fee structure cannot be properly implemented, and keeping things simple and straightforward, where possible, is beneficial to both ComReg and the licensees.

Annual fee, indexed to inflation

Under rolling annual licences (with a high degree of certainty of renewal), the licence fee would be paid annually. We do not see any need for a difference in fees between years, i.e. there would not be an upfront fee to pay upon first application and a different fee for each year of renewal. However, we expect that the annual fees would be indexed to inflation, as is standard practice across many ComReg licensing regimes.

12.2 Approaches elsewhere

Ideally, the final fee levels will not be significantly out of line with those applied in other European countries.

The structure of licence fee differs across countries. In the UK, Belgium and Norway, where the licenced spectrum are in the 3.8-4.2 GHz band, licensees pay an annual fee. Each country charges a fee on different bases. In the Netherlands, where entities may apply for one or both of the 3400-3450 MHz and 3750-3800 MHz sub-bands, licensees pay a one-off fee in the beginning and an annual fee based on the number of base stations. In Germany, licensees pay a one-off fee for a licence in the 3.7-3.8 GHz band, the calculation of which takes licence duration, area, and bandwidth into account.

Table 2 summarises the fee structures in other countries.

Table 1: Summary of fees in other countries

<table>
<tr><td>Country</td><td>The UK</td><td>Belgium</td><td>Norway</td><td>The Netherlands</td><td>Germany</td></tr>
<tr><td>Band</td><td>3.8-4.2 GHz</td><td>3.8-4.2 GHz</td><td>3.8-4.2 GHz</td><td>3400-3450 MHz / 3750-3800 MHz</td><td>3.7-3.8 GHz</td></tr>
<tr><td>Annual/one-off</td><td>Annual</td><td>Annual</td><td>Annual</td><td>One-off + Annual</td><td>One-off</td></tr>
<tr><td>Fee structure</td><td>£80 for every 10 MHz (low and medium power alike)
£160 for every 10 MHz for medium power in urban area
€1 = £0.85</td><td>€400 per MHz per km^2
Note: Licences in Belgium are capped at 40 MHz.</td><td><table><tr><th>Bandwidth</th><th>Low power (per licence area*)</th><th>Medium power (per base station)</th></tr><tr><td>20 MHz</td><td>NOK 200</td><td>NOK 1000</td></tr><tr><td>40 MHz</td><td>NOK 400</td><td>NOK 1400</td></tr><tr><td>60 MHz</td><td>NOK 800</td><td>NOK 2200</td></tr><tr><td>80 MHz</td><td>NOK 1600</td><td>NOK 3800</td></tr></table>* The licence area is defined as a geographical position (stated in the application) and with a radius of 50 metres in which bases stations can be deployed. Multiple licence areas may be applied for.
€1 = NOK 11.55</td><td>€268 one-off fee +
annual fee of €101 per base station</td><td>$Fee\ (€) = 1000 + B \cdot t \cdot 5 \cdot (6 \cdot a_1 + a_2)$
$B =\ bandwidth\ in\ MHz\ (from\ 10\ to\ 100)$
$t = the\ assignment\ period\ in\ years$
$a = the\ surface\ area\ in\ km^2$
$a_1 = settlement\ and\ transport\ land$
$a_2 = other\ types\ of\ land$</td></tr>
</table>

Sources:

- *UK: Enhancing Shared Access Framework, Ofcom, 2024 (https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-1-10-weeks/consultation-supporting-increased-use-of-shared-spectrum/associated-documents/statement-enhancing-the-shared-access-framework.pdf?v=386190)*

- *Belgium: Chapter 4 Article 8 of Royal Decree concerning private broadband local radio networks of 4th June 2023 (https://www.ejustice.just.fgov.be/cgi/article.pl?language=fr&sum_date=2023-07-27&lg_txt=f&pd_search=2023-07-27&s_editie=&numac_search=2023042829&caller=&2023042829=&view_numac=2023042829n)*
- *Norway: Regulation of local networks in 3.8-4.2 GHz, Nkom, 2023 (https://nkom.no/frekvenser-og-elektronisk-utstyr/frekvenser-til-mobilkommunikasjon-og-5g/tilrettelegging-for-lokale-mobilnett-i-3-8-4-2-ghz/_/attachment/download/cedba85d-febe-41ab-bfba-348a118f7150:2288b83dfe5e9deea2bf5c153a397354a795b0cf/Regulation%20of%203,8-4,2%20GHz%20December%202022.pdf)*
- *Netherlands: Section I.B.1 of the Regulation on reimbursements for the National Digital Infrastructure Inspectorate (https://www.rdi.nl/onderwerpen/private-netwerken/perceelgebonden-netten)*
- *Germany: Administrative rules for spectrum assignments for local spectrum usages in the 3700-3800 MHz band, BNetZa (https://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/Areas/Telecommunications/Companies/TelecomRegulation/FrequencyManagement/FrequencyAssignment/LocalBroadband3,7GHz.pdf?__blob=publicationFile&v=1)*

Annex A PMR licence conditions

PMR operation is covered by six distinct licence types, plus permits for paging:

- **Business radio** systems communicate on a one-to-all basis (whether transmission comes from a fixed control point or a mobile terminal). Licences are to operate in a defined geographic area for a year;
- **Third party business radio (TPBR)** users are similar to standard business radio users, but licences last for five years, and allow holders to lease radio equipment and spectrum access to third parties;
- **Mobile radio system (trunked radio)** use a pool of channels that can be accessed by any user. Similar to business radio licences, trunked radio licences last for one year and can be renewed annually;
- **Community repeater** systems are comprised of a base station (typically in a remote position on a high site), trigger station, and mobiles allow equipment providers to offer use of a base station, and provide two way communications services to a number of users on a channel sharing basis;
- **Telemetry** systems transmit automated measurements from remote locations to receiving stations for monitoring and control purposes. Licences last up to ten years and are assigned on a first come first served basis.
- **Programme making and special events (PMSE)** licences allow the operation of radio equipment at a given location/event, for a time specified on the licence, not exceeding six months; and
- **Paging** systems send one-way coded signals (e.g. a beep or a text message) to a paging receiver owned by a subscriber. There are no regulations for paging systems, which only require a permit rather than a licence, and are not subject to any fees or expiry dates.

Certain devices that are unlikely to cause significant interference (e.g. consumer grade walkie-talkies with non-interchangeable antennas) are permitted to use spectrum on a licence-exempt basis. This includes PMR 466 MHz, which is licence-exempt for personal use in Europe.

The conditions for use of each of these licence types are spread across a range of guidance documents and are summarised in the table below.

Table 2: PMR licence conditions

Licence type	ComReg Document	Bands	Channel spacing	Equipment	Duration	Geographic scope	Fees
Business radio	00/07aR2	VHF low VHF high UHF	12.5 kHz	Base station Mobile station Portable station	1 year (renewable)	Onsite (<2 km) User defined area (2-35 km) Region	€22 processing fee plus €22 per radio
TPBR	05/82R5	VHF high UHF	12.5 kHz	Base station Mobile station Portable station	5 years	National	€5,000 per channel
Trunked radio	07/57R1	385-400 MHz (digital)	12.5 kHz 25 kHz	Base station Mobile station	1 year (renewable)	On site (<2 km) Wide area	Year 1 - €625 per channel per base

		415-430 MHz (analogue)					Year 2 onwards - €1,000 per channel per base
Community repeater	02/03R1	VHF low UHF	12.5 kHz 25 kHz	Base station Trigger station Mobile station	1 year (renewable)	Wide area	Year 1 - €625 plus €12 processing fee Year 2 onwards - €1,000
Telemetry	14/56R1	VHF high UHF	12.5 kHz (12 channel block for national licences)	Base station Out station Repeater station	Renewable annually for up to 10 years	On site (<1 km) Local area (<12.5 km) Wide area (<25 km) National	On site - €109 Local area - €436 Wide area - €872 National - €39,240

PMSE	08/08R6	VHF high UHF 1980-2400 MHz U6 GHz L7 GHz 10.3-10.5 GHz	12.5 – 200 kHz (VHF/UHF) 10-20 MHz (higher frequencies)	Wireless microphones Portable station, IEM Wireless camera Base station Repeater station Data and telemetry devices	Up to 6 months	On site	€12 fixed charge plus €12 per piece of equipment
Paging	0			Base station Receivers	No expiry	On site Local area	

Table 3: VHF/UHF PMR frequency bands

Band	Frequencies (MHz)	Licence types
VHF low	68-87.5	Business radio, community repeaters
VHF high	163-174	Business radio, TPBR, regional telemetry
UHF	385-390/395-400	Trunked radio (digital)
UHF	415-419/425-429	Trunked radio (analogue)
UHF	450-470	Business radio, community repeaters, TPBR, regional telemetry, national telemetry

Frequencies used for different PMR licence types tend to fall into the same ranges within the VHF and UHF bands, with the exception of trunked radio which uses slightly lower frequencies. Analogue trunked radio is used in the 410-430 MHz range[32], whereas the digital trunked radio frequency ranges neighbour the frequencies available on TETRA emergency service digital radio (380-395/390-395 MHz).[33]

[32] ComReg 07/57

[33] ComReg 08/67

Annex B PMR International best practice

By their nature, PMR projects are usually location specific. Even the wider area uses are only national in scope. International competition is therefore less of a concern to regulators and international coordination, while still needed, is simpler.

The terminology used to describe these projects varies by regulator and entity. Commonly used terms in regulatory documents that fall under ComReg's PMR licensing include private mobile radio (PMR), professional mobile radio (PMR), programme making and special events (PMSE), electronic news gathering (ENG), outside broadcast (OB), services ancillary to programme making (SAP), services ancillary to broadcasting (SAB), land mobile systems, short range devices (SRD), paging systems, inner ear monitoring (IEM) and wireless audio.

B.1 Harmonisation measures

B.1.1 ITU

The ITU provides recommendations on spectrum allocations and technical parameters for all users, including PMR and PMSE. Notably, ITU-R Report BT.2344-2(04/2018) provides guidance on the use of what the ITU refers to as SAP, SAB, OB, and ENG, all of which fall under ComReg's PMR header.

PMR users have been impacted by recent ITU decisions to allocate a growing list of frequencies to mobile use and 5G deployment. Decisions from WRC-07 and WRC-12 allocate frequencies between 694 and 862 MHz (previously used by PMSE and PMR) to the mobile service on an exclusive basis, reducing possible PMR frequencies and requiring PMR users to migrate to new frequency bands.

B.1.2 European Commission, CEPT and ECC

The European Commission provides direction to member states based on recommendations made by the European Conference of Postal and Telecommunications Administrations (CEPT) and

the Electronic Communications Committee (ECC), regarding allocation, harmonisation, and technical requirements for radio use in Europe. National regulators in member states can then make their own decisions as to which recommendations to adopt and how to best allocate spectrum to meet their needs. A number of ECC decisions and CEPT/ECC recommendations relate to the use of PMR in Member states. Here we present a non-exhaustive list of the European documents most relevant to PMR and brief descriptions of those publications.

ECC Decision (19)02 and ERC Recommendation 25-08– *On land mobile systems in the VHF and UHF bands.*

Decision (19)02 officially adopts the recommendations laid out by the ECC regarding spectrum to be used for PMR. The documents include a list of potential frequency ranges to open, in the ranges of 68-87.5 MHz, 146-174 MHz, 406.1-410 MHz, 410-430 MHz, 440-450 MHz and 450-470 MHz. The ECC recommends that member states use their discretion to select the frequency ranges from this list that work best within their national frequency allocation plans, while ensuring the available spectrum is enough to satisfy demand for PMR spectrum.

ECC Decision (15)05 – *On PMR 466 applications.*

Establishes and harmonises the frequency range 446.0-446.2 MHz to be used by PMR and operated on a collective and uncoordinated basis. This spectrum is shared by many users and exempted from licensing, subject to the meeting of certain technical parameters. The recommendation also highlights the importance of member states having sufficient spectrum available for both analogue and digital systems and specifies separate frequency ranges for each type of use, as users continue to switch from analogue to digital at increasing rates.

EC Decision 243/2012/EU – *Establishing a multiannual radio spectrum policy programme.*

The Decision, which includes freeing up the 800 MHz band for wireless broadband use, specifies that member states shall take care to ensure existing PMSE users in this band are not adversely affected by the new allocation and necessary relocation of PMSE use. Regulators should also ensure there is sufficient spectrum available to satisfy demand for PMSE.

ECC Report 204 – *Spectrum use and future requirements for PMSE.*

In this report, the CEPT recommends that regulators in member states assign tuning ranges for use by SAP/SAB services from an

included list of specified frequencies, allowing for some divergence in national decisions and discretion by national regulators. The report also advises that manufacturers make equipment with wide switching and tuning ranges to accommodate the widest possible uses and users. The document builds off of the requirements for PMSE and licence-exempt SRD use set out in ECC Recommendations 25-10 and 70-03.

ERC Recommendation 25-10, as revised *– for Terrestrial Audio and Video PMSE applications.*

Directs CEPT member states to assign frequencies from an included list to use by SAP and SAB users, and advises equipment be made with wide tuning ranges to accommodate growing use.

ERC Recommendation 70-03 *– Relating to the Use of Short Range Devices (SRD)*

Specifies frequency ranges, technical parameters and other requirements for the use of SRD. In meeting these requirements, SRD use is then licence-exempt. Further, the decision recommends that member states allow foreign visitors to use their own SRD equipment temporarily without restrictions. This recommendation follows on other decisions and reports, such as EC 2006/771, establishing licence-exempt use for certain SRD systems.

B.1.3 ETSI

ComReg requires PMR operators to use equipment that conforms to ETSI standards. These standards are the basis for some of the technical restrictions placed on PMR licences, and abiding by them reduces the risk of harmful interference between operators.

ETSI has produced a range of documents that gives a comprehensive set of rules for PMR equipment. ETSI documents that may be relevant to PMR include:

- EN 300 086-2;
- EN 300 113-2;
- TS 102 362 and TR 102 362 for digital mobile radio.

The same ETSI standards apply to different types of PMR equipment, although in some cases they distinguish licence exempt use (i.e. PMR 466) and trunked radio from the remainder of PMR equipment.

B.2 Features of European PMR frameworks

B.2.1 ECC Report 292

ECC Report 292 reviews the use of frequencies in the 400-470 MHz range for PMR (in particular 410-430 MHz and 450-470 MHz). This includes the results of a survey on PMR use across CEPT administrations, which found a great deal of variation across countries in the extent of PMR use, prevalence of digital/analogue systems and the types of licence available. It also found that most licences are for frequencies in the 450-470 MHz range, followed by 440-450 MHz and then 410-430 MHz, and that while some licences are for more than 25 kHz, these tended to be nationwide licences accommodating a large number of devices. Low or even insufficient availability of spectrum (in urban areas) was raised as an issue in some countries, which the ECC suggests could be resolved by e.g. spectrum sharing.

The ECC Report suggests the following options that administrations could employ in their PMR regimes:

- fostering the use of the VHF band (e.g. by setting lower fees or more relaxed technical conditions);
- increasing shared use of PMR channels;
- increasing frequency opportunities for digital use;
- achieving more contiguous band segments for wideband and broadband use;
- taking a more flexible approach to licensing, by allowing trading/leasing of licences and offering licences on a technology neutral basis; and
- defining area licences.

Regarding spectrum sharing, the ECC suggests regulators could set a 'sharing number' (initially of two) and that some number of users up to that sharing number would be able to use the same spectrum in overlapping areas, which is already a feature of Ofcom's approach. It sees this as akin to making additional spectrum available in contexts where there are a large number of uncoordinated users – while there are other efficient means of sharing spectrum between users (i.e. trunking) these largely rely on coordinated, exclusive use of a block of spectrum. The ECC notes that sharing would be more effective when traffic is in short bursts, such that the probability of clashes is low

(including both voice and data traffic that "*mimics voice transmission in the time domain*").

This report points to two other ECC documents relevant to PMR regimes, noting that "*Recommendation T/R 25-08 supports the deployment of the new technology-neutral ECC Decision (19)02 for land mobile systems in the frequency ranges 68-87.5 MHz, 146-174 MHz, 406.1-410 MHz, 410-430 MHz, 440-450 MHz, and 450-470 MHz*", which we summarise above.

B.2.2 Ofcom

Certain features of Ofcom's PMR licensing regime have been highlighted in the stakeholder interviews and in ECC Report 292 as potentially helpful, were they to be included in ComReg's framework.

Ofcom offers five types of PMR licence[34]:

- Simple UK Light – a national licence that does not permit the use of base stations;
- Simple Site Light – an on-site licence that does permit the use of base stations;
- Suppliers Light – allowing holders to hire out business radio equipment;
- Technically Assigned – for which the coverage area is determined as part of the licence application process; and
- Area Defined – which covers either a 50 km^2 grid square, a 'country' (i.e. England, Scotland, Wales or Northern Ireland), or the whole of the UK.

Holders of any of any of the 'light' licence types must self-coordinate with other users of the spectrum. For technically assigned, exclusive and shared options are available – for shared licences, up to the 'sharing factor' number of users may be permitted to use the same frequencies in an overlapping geographic area. The sharing factor was initially two, but is set to rise to four following a recent consultation.[35]

The UK does not align with the European configurations of the UHF frequencies available to PMR operators, but makes relatively heavy use of the 440-450 MHz range in UHF Band 1.

[34] https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/business-radio/guidance-for-licensees/business-radio-faqs

[35] Ofcom Strategic Review of UHF Band 1 and Band 2, https://www.ofcom.org.uk/__data/assets/pdf_file/0017/102185/Statement-on-strategic-review-of-UHF-Band-1-and-Band-2.pdf

Some stakeholders have suggested that access to these frequencies in Ireland would be helpful, because equipment from the same vendors is used in both countries.

Annex C Licence and survey data

C.1 Number of licences

We have ComReg licence data for each type of PMR licence. Most PMR licences are business radio licences - pager permits are a lighter form of authorisation, and as they do not expire, the total number in active use is uncertain. Pager permit data is less detailed and less reliable than the licence data for the proper licence types. Nevertheless, it does show us that new permits continue to be issued, on top of the substantial number of existing permits. The numbers of live licences for the other types of PMR licence are well below that of business radio licences, but some of them cover multiple users, and PMSE licences have a shorter duration, such that the number live at a point in time may be significantly below the amount of licences used over a longer period of time, e.g. there were 109 licences active at some point in the three months to March 2024, well above the number that were live at that point in time. These licences are spread across a large number of operators and most use spectrum in the UHF band (as paging permits do not expire, the greater proportion of these being in the VHF band reflects heavier use of that band in the past).

Table 4: Number of licences by type

Licence type	Operators	Licences	% UHF
Business Radio	736	1,078	78
Community Repeater	3	3	100
National Telemetry	2	3	100
PMSE	27	54	-
Pager Permit	-	166	87
Regional Telemetry	7	8	88
TPBR	17	75	87
Trunked Radio	19	39	100

Below, we present some of the broad trends seen in the licence data. The data available varies across licence types (owing to their different structure, which makes different parameters relevant). The small number of live licences for many licence types also makes certain cuts of the data less meaningful, therefore below we often focus on a subset of the available licence types (generally business radio). The number of licences shown in this annex may differ from that used in the fees section, owing to missing values or differing variables across datasets – the fees section requires only few variables, whereas this annex explores licence parameters more broadly.

We construct a quarterly time series of live licences by taking the first day of the second month of each quarter and checking, at each date, which licences had been issued but had not yet expired or been cancelled. Owing to missing values, there are some licences for which we cannot determine when the licence was issued or expired, but generally affects less than 5% of the licences of each type - we have no reason to believe this affects the broad, high level trends that we show below. We count licences based on unique licence reference numbers.[36]

C.2 Licence characteristics

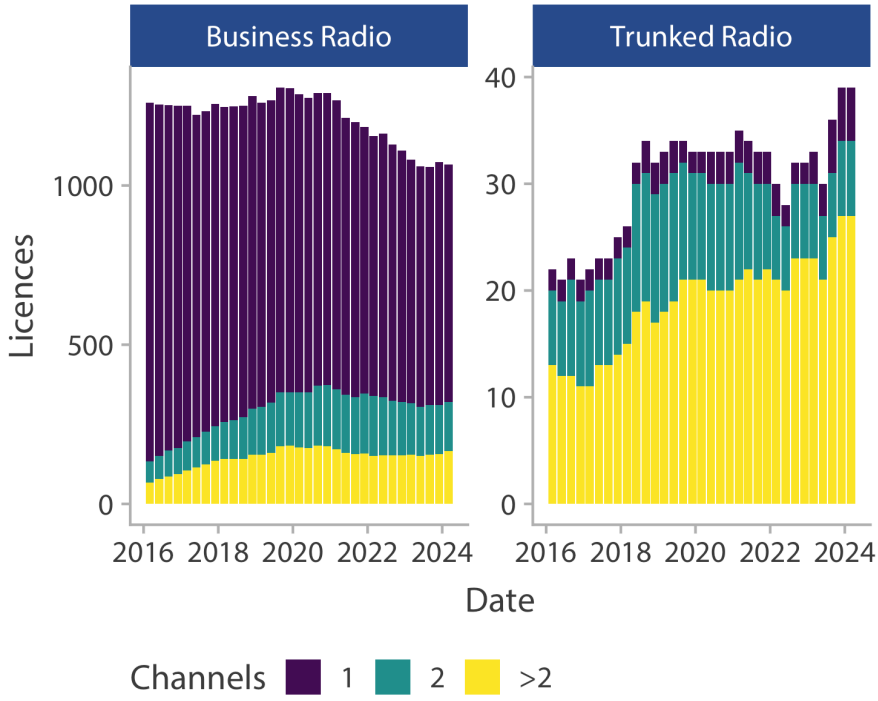
C.2.1 Bandwidth

PMR operators have modest bandwidth requirements, generally using 12.5 kHz channels. In some cases, 6.25 kHz and 25 kHz channels may be used, but the only case of significantly larger bandwidths is for certain types of PMSE equipment. We might also see evidence of PMR operators' demand for bandwidth through the number of channels used on the same licence. For business radio licences we count the number of distinct channels used on the same licence and in the same area (with the same geographic scope and in the same county). We then plot the number of licences using one, two or more than two channels over time - use of one (12.5 kHz) channel is the most common, however use of two or more channels has increased over time, before flattening off over the last few years.

[36] A single licence (reference) covers multiple rows in the licence data e.g. when different types of equipment connected to the same licence are recorded. For certain users, e.g. public transport, there may be a large number of entries under the same business radio licence.

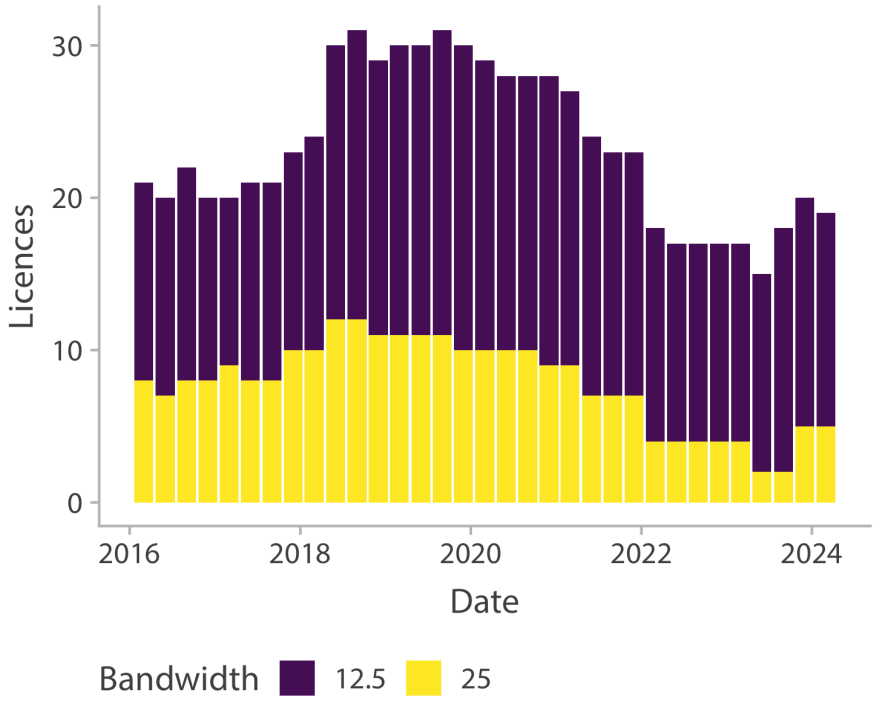
It would not be meaningful to plot the number of channels held by a licensee for some of the other licence types. In particular, TPBR licensees with multiple channels could be using them to supply to a range of different third parties, such that the total number of channels held by a licensee might significantly exceed the bandwidth needs of any one user.

Figure 6: Number of channels



Trunked radio licences typically cover a larger number of channels, because the technology itself aims to be an efficient way of sharing a pool of channels between users. For this licence type, we can also look directly at the channel widths in use - a reasonable proportion of licences are for 25 kHz channels, but there is no trend towards larger bandwidths.

Figure 7: Trunked radio bandwidths



C.2.2 Location

For business radio licences, we can look at how users are distributed throughout Ireland. While these are used throughout the country, almost 40% of licences are for use in Dublin. We are not aware of any significant issues of congestion or a scarcity of channels, nor do the bandwidth needs or arrangement of licensees in the available spectrum suggest there is scarcity. Should scarcity arise in future, however, this is most likely to be in Dublin. On the other hand, the survey respondents who indicated that they have had difficulty finding available channels are not concentrated in Dublin.

Table 5: Business radio licence distribution by county

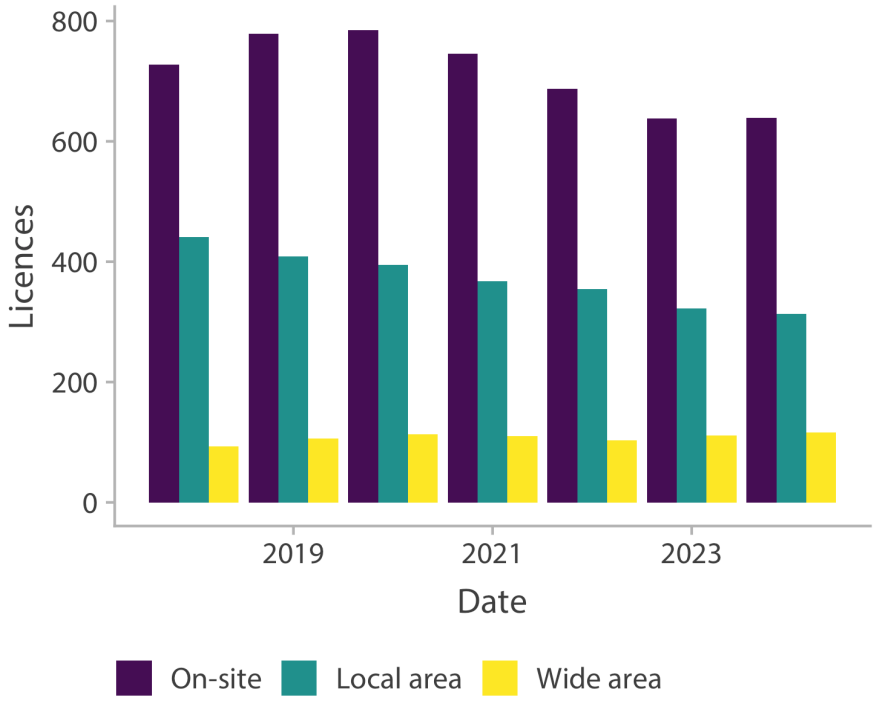
County	% BR licences
Dublin	40.7
Cork	13.0
Kildare	4.9
Galway	3.5
Limerick	3.5

County	% BR licences
Tipperary	3.1
Louth	3.0
Kerry	2.9
Meath	2.8
Donegal	2.2
Wicklow	2.2

C.2.3 Geographic scope

Among business radio licences, narrower geographic scopes have consistently been more common. Other licences types typically cover wider areas, but it is not always obvious how this relates to end use cases (i.e. although TPBR licences are national, they can be used to serve customers deploying on-site business radio systems). The graph below shows the number of live business radio licences with each geographic scope (averaged across the four quarters). Data on geographic scope is missing for a significant proportion of licences prior to 2018, so earlier years are not included.

Figure 8: Business radio geographic scope



C.3 Use cases

In many cases the nature of the licensee's use case and industry are unclear from the licence data and we observe nothing about which licence parameters have lead them to select a particular licence type. In this section, we look at responses to our survey of PMR licensees, which among other things covered use cases and operators priorities when selecting licences.

Consistent with the licence data discussed above, on-site communication was the most common use case, and most use cases rely primarily on business radio licences. Naturally, telemetry and control operators more commonly use telemetry licences, although they also use business radio licences for on site communication. Those who selected 'other' in response to the use case question were invited to write in their use case - most of these corresponded to emergency services or related uses. PMR operators are spread fairly evenly across a range of industries.

Figure 9: Use cases by licence type

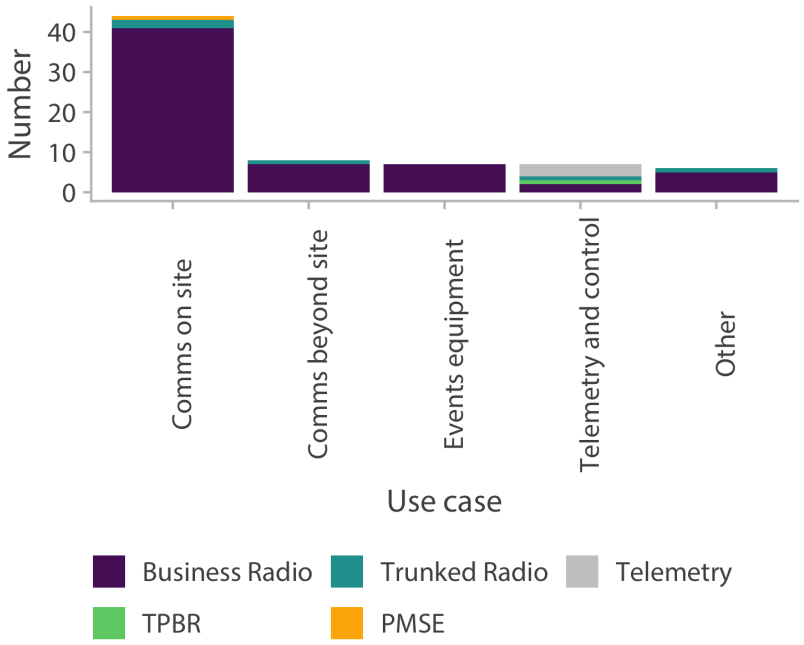
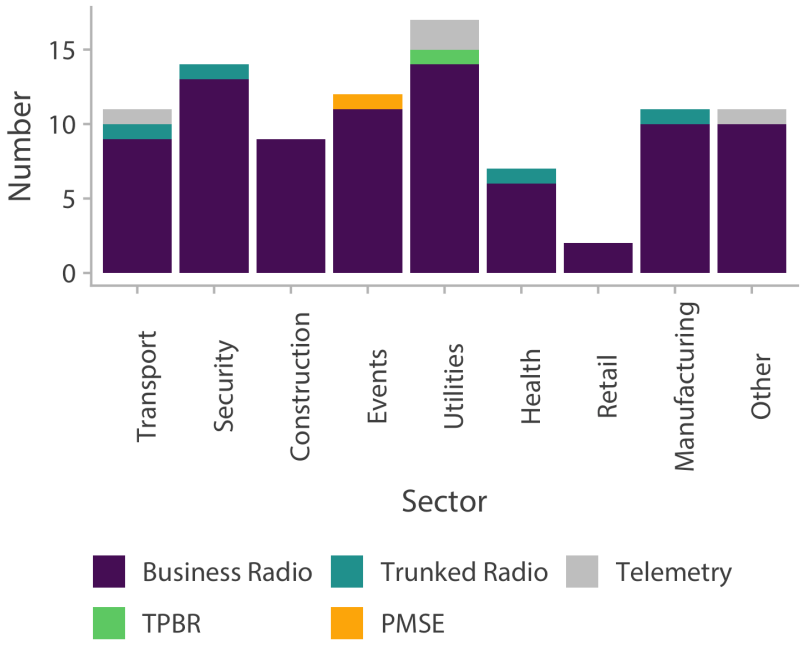


Figure 10: Sectors by licence type



Operators were asked to rank the parameters in order of importance (from 1 to 7) separately for each licence type and the responses are summarised in the figure below, where the width of the bars corresponds to the number of respondents ranking that parameter in that position. Preferences over licence parameters were consistent across licence types, with exclusive

use of channels and geographic scope being the most important parameters for all licence types, although licence duration was more important for telemetry and TPBR licences than for other types.

Figure 11: Licence parameter preferences