Workshop with techUK and SPF

Use case requirements in the 3.8–4.2GHz band via Ofcom's SAL framework

Janette Stewart, Luwen Meng, Jack Wee Ng

26 September 2023

8884698679-381 | Confidential

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The following slides provide a summary of findings from Analysys Mason's study into the use cases in the 3.8–4.2GHz and UK's shared access licensing (SAL) framework

Background to the study

- The purpose of the study has been to investigate use cases of spectrum in the 3.8–4.2GHz band, available in the UK via Ofcom's shared access licensing (SAL) framework
- Key questions for the study were to consider how use cases might evolve, and how future developments in use cases, and demand for licences, could impact evolution of the SAL framework conditions
- The study has been based on a combination of desk research, plus one-to-one interviews with selected stakeholders (including current users of SALs, equipment vendors and other stakeholders)

Status of the study

- A draft final report has been prepared and submitted to the techUK team
- The purpose of this presentation is to describe how we approached the study, and our draft findings

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We have captured a range of evidence during the study from desk research and through a series of one-to-one interviews with stakeholders

- The study has been based on a combination of desk research, and one-to-one interviews with selected stakeholders (including current users of SALs)
- Sources of information have included:
  - **Ofcom's Wireless Telegraphy Register (WTR)**: the main source for analysing current uses of the 3.8–4.2GHz band
  - **Ofcom's 'Call for inputs' consultation**: we reviewed the main consultation file and responses stakeholders
  - **published information on private 5G networks:** sources include an Analysys Mason Research private networks tracker, GSA's private mobile networks tracker and other sources, such as vendor and operator websites

We would like to thank all the members/organisations who have provided their views to support this study

- We completed eight interviews with selected stakeholders to inform our analysis
  - these stakeholders included companies active in the SPF, and outside of the SPF
  - stakeholders included 5G vendors, IoT and media equipment vendors, UK fixed and mobile network operators, 5G fixed wireless access (FWA) providers and media companies
- Several aspects of using the 3.8–4.2GHz band and the SAL framework have been discussed during the interviews, including:
  - current use cases, and expected trends in deployment
  - related technical deployment requirements, such as power levels, area coverage and bandwidth requirements
  - issues identified with the current assignment process
  - licensing tool and suggestions for more efficient licence issuance

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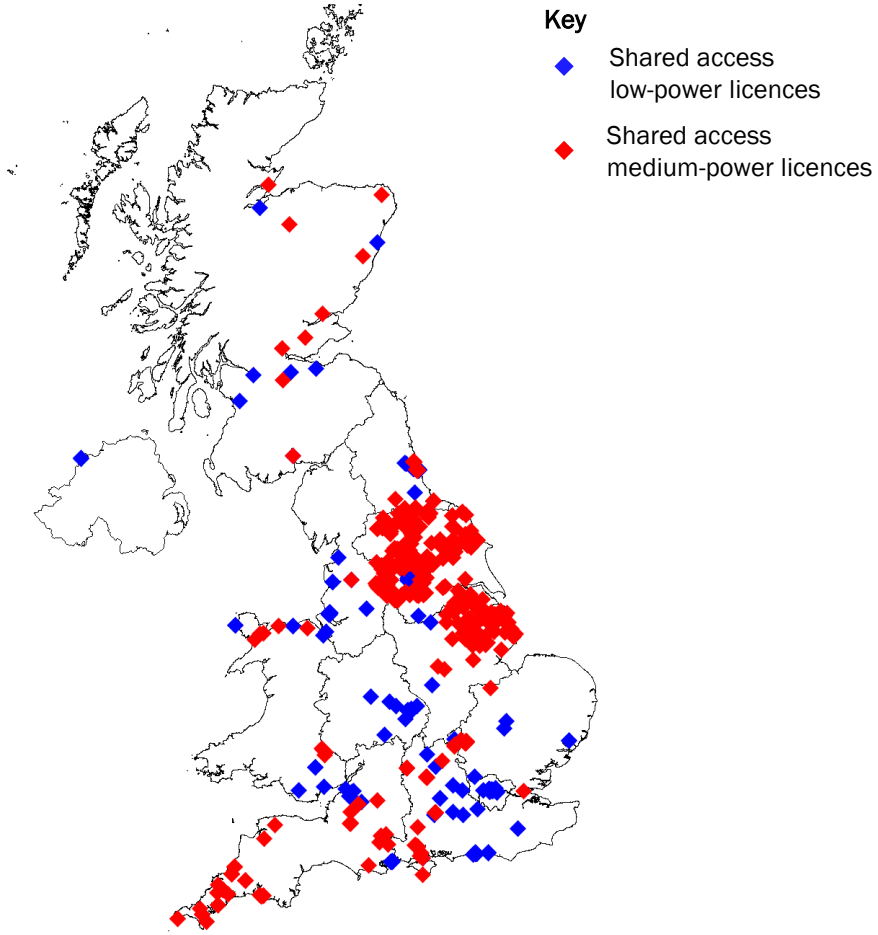
According to Ofcom's WTR in July 2023, there were 674 live SALs across the UK,[1] most of which are located in England but with a spread across other locations

Map of existing SALs in the 3.8–4.2GHz band



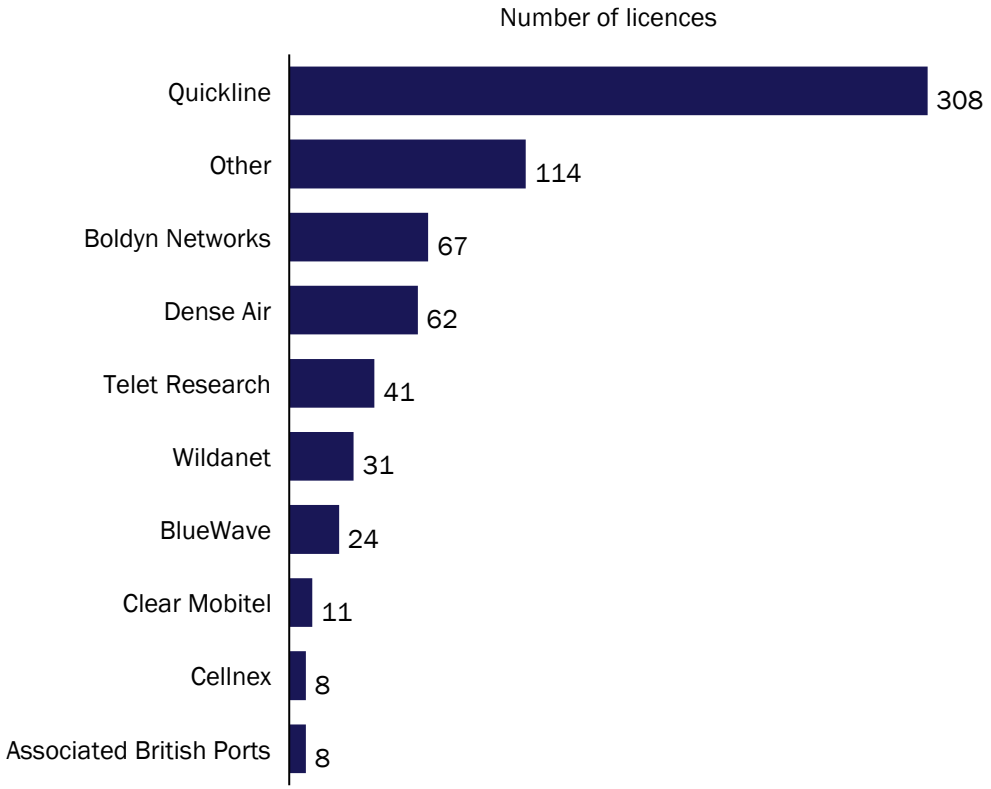
- Of these 674 SALs in the 3.8–4.2GHz band, over half are used for rural broadband services
  - Quickline, a broadband service provider for Yorkshire and Lincolnshire, holds the majority of SALs in this band i.e. 308 licences in total in July 2023
- Other commercialised uses of the band are mostly seen in ports and manufacturing industries, as well as live broadcasting events
  - stakeholders suggested during the interviews that many current deployments are still at trial/proof-of-concept stage
  - indications that the ecosystem is now progressing in this band should also encourage further adoption
  - we note that the Department for Science, Innovation and Technology (DSIT) has published a 5G innovation funding opportunity (September 2023 deadline), which could increase the number of applications for SALs in the 3.8–4.2GHz band to support new funded projects

[1] The analysis is based on the WTR extracted in July 2023, and the latest WTR (extracted in September) suggests that the number of total SALs in the 3.8–4.2GHz has now reduced to 602 (with a reduction in licences granted for FWA purposes)

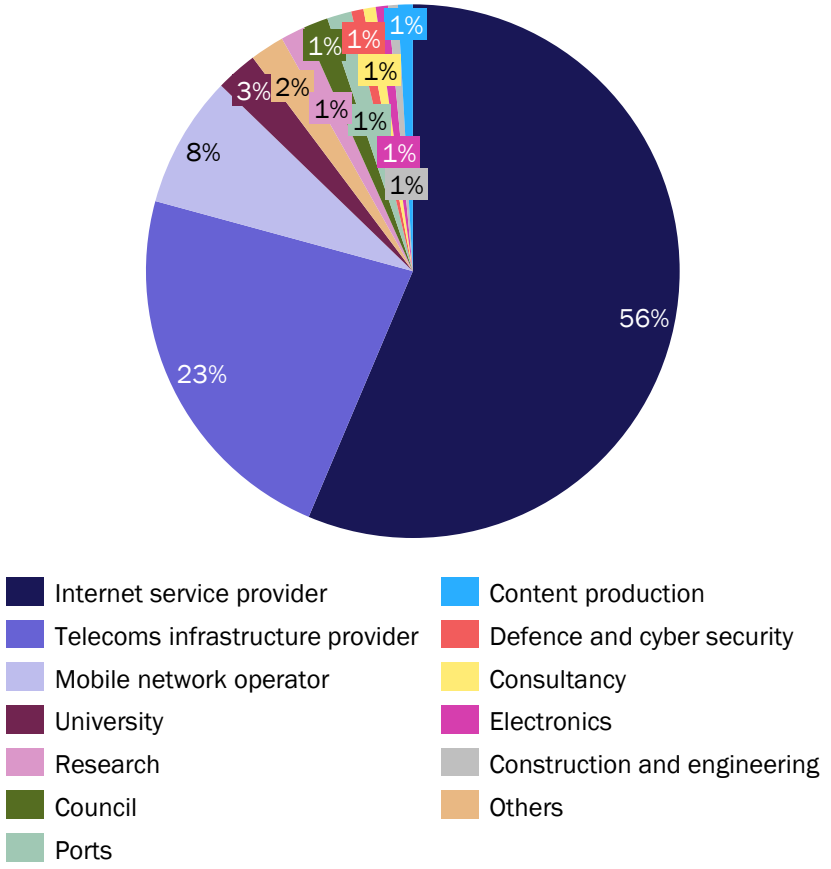
 Source: Analysys Mason based on Ofcom's WTR (July 2023)

Out of 674 SALs using the 3.8–4.2GHz band as of July 2023, over half of the issued licences were being utilised for rural broadband services delivered via 5G-FWA

3.8–4.2GHz SALs distribution by company



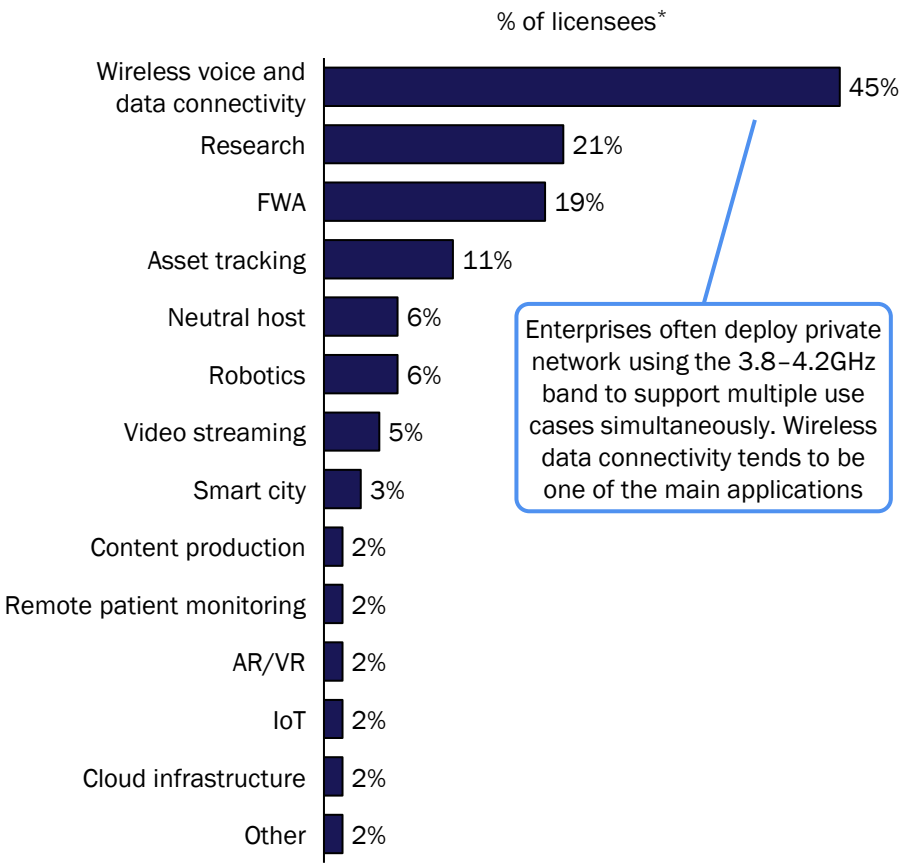
Vertical sectors by the number of existing 3.8–4.2GHz SALs



 Sources: Analysys Mason based on Ofcom's WTR (July 2023), press search

Many SALs are being used to provide locally customised wireless data connectivity solutions, with specific use cases including FWA, IoT, tracking, robotics and AR/VR

Use cases of 3.8–4.2GHz SAL by user group



Examples of 3.8–4.2GHz SAL current use cases

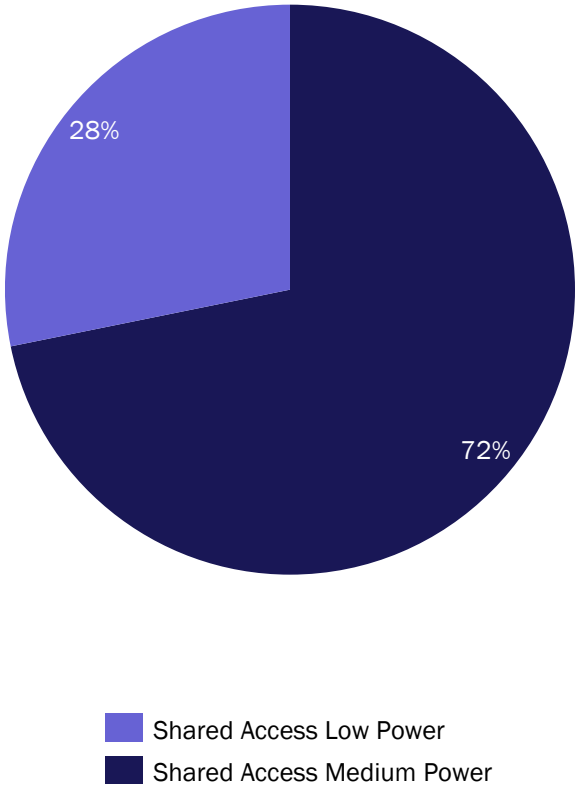
Use case	Examples
Wireless data connectivity	▪ Ferrovial, a construction and engineering firm, has deployed private 5G network at its Silvertown Tunnel construction site to enable wireless connectivity in the tunnel and enhance site communications, access management and perimeter control
Research	▪ The University of Sheffield Advanced Manufacturing Research Centre has deployed an on-premise dedicated private 5G network
FWA	▪ Quickline has announced that it has developed and commercialised a 5G standalone, cloud-native OpenRAN network that utilises the specified spectrum band for FWA services in selected locations
Asset tracking	▪ Associated British Ports have deployed private 5G network at the Port of Southampton to provide the port with a reliable and secure private wireless data network
Neutral host	▪ Dense Air has launched a 5G standalone neutral host network in Millbrook, that allows connected and autonomous vehicle testing
Robotics	▪ BT has deployed a purpose-built private 5G network at the Manufacturing Technology Centre's manufacturing research facility in Coventry, in partnership with West Midlands 5G (WM5G) and Worcestershire 5G (W5G) programme
Smart city	▪ Milton Keynes Council launched the MK:5G project in 2021, which is a testbed in the Milton Keynes area for the deployment of dedicated local 5G infrastructure

* In total, there are 62 unique licence holders as of July .

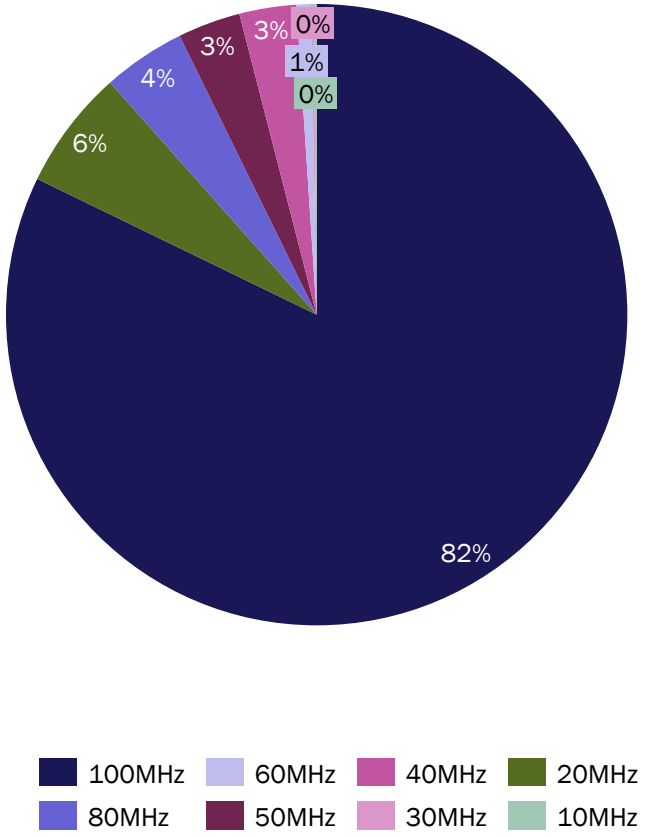
 Source: Analysys Mason based on Ofcom's WTR (July 2023), press search

According to Ofcom's WTR, most of the 674 licences issued for the 3.8–4.2GHz band were using medium power, and were using 100MHz bandwidth

Power limit of 3.8–4.2GHz SALs issued



Bandwidth of 3.8–4.2GHz SALs issued



 Source: Analysys Mason based on Ofcom's WTR (July 2023)

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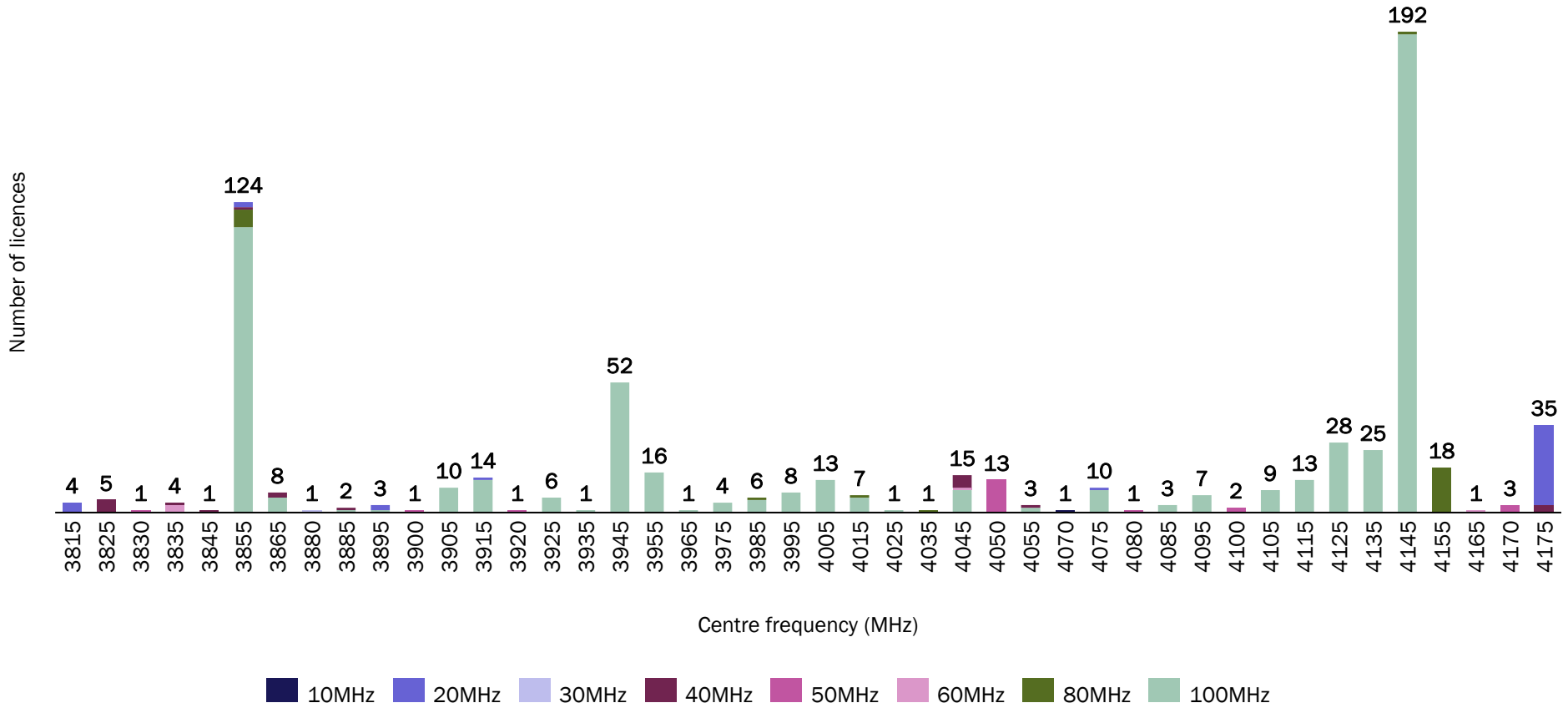
Our analysis suggested most 100MHz bandwidth licences were assigned by Ofcom in the lower or upper part of the band, but with a broad spread across the band

Number of SALs in the 3.8–4.2GHz band per bandwidth per centre frequency



 Source: Analysys Mason based on Ofcom's WTR (July 2023)

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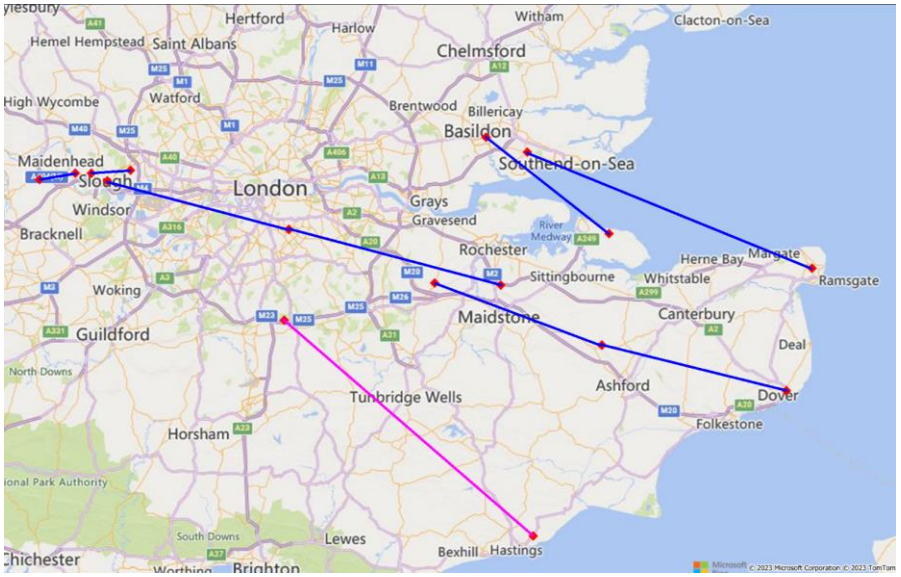
The 3.8–4.2GHz band accommodates fixed links, earth stations, and Three's national 3.9GHz spectrum, and Ofcom applies a co-ordination process for SALs

Map of existing fixed-link licences in the 3.8–4.2GHz band



Key

- Licensed fixed links held by Optiver Services
- Licensed fixed links held by Wholesailor

- UK Broadband Ltd,[1] now owned by Three UK, holds a national licence for the 3.9GHz (3.925–4.009GHz) band
  - according to the licence terms, the company is required to co-ordinate with other users, which includes SAL uses
  - from the previous slide we can see that Ofcom has authorised some SALs within UK Broadband's spectrum

Map of permanent receiving-only Earth stations (ROES) with centre frequency falling in the 3.8–4.2GHz band[2]

[1] UK Broadband Ltd was acquired by the mobile network operator Three in 2017; [2] This map is generated based on Ofcom's Space Spectrum Strategy, with data sourced from Ofcom's spectrum licensing database December 2015

 Source: Ofcom

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We found SALs are currently being used for 5G-FWA, private 5G networks and live media, and that the specific use cases being deployed will expand and evolve

Summary of evolution of use cases

	Use cases	Technologies to deliver the use cases	Outdoor/indoor deployments	Bandwidth
Current deployments	▪ Sensors on cranes at ports and other data, video and IoT applications ▪ Live video content for television broadcasting ▪ Fixed-wireless access (FWA) networks for broadband connectivity in rural areas	▪ 5G new radio (5G-NR) in standalone (SA) configuration	▪ Indoor and outdoor	▪ 10–100MHz
Potential future evolution	▪ *Augmented/virtual-reality (AR/VR) applications, robotics and autonomy in several industrial sectors* ▪ *Video upload from live events* ▪ *Tailored private wireless networks in specific environments (such as hospitals and manufacturing)* ▪ *One potential new use case is wireless microphones/audio systems*	▪ *Most evolving use cases appear likely to continue to use 3GPP n77 products* ▪ *There is interest from potential providers of DECT-NR+ products in using the 3.8–4.2GHz band for wireless microphone use or for IoT via DECT-NR+*	▪ *Growing demand for localised outdoor deployments may be expected (such as FWA uses, ports, airports, factory sites with multiple buildings)* ▪ *Seamless connectivity for a combination of indoor and outdoor environment in a given location (such as automated guided vehicles in warehouses)*	▪ *Larger channel widths (80MHz or 100MHz, or above) may still be dominant options for greatest capacity to accommodate a widening range of use cases* ▪ *Potential demand for larger bandwidths (such as 200MHz) as use cases evolve, such as for AR/VR use*

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It could be beneficial to account for antenna characteristics in the co-ordination process, and consider how locations for medium power base stations are defined

Summary of recommendations on technical conditions for SAL framework

Medium power licence authorisations	▪ Our research suggests that there is interest in allowing applications for medium-power licences in non-rural postcode areas, and hence it could be desirable to consider if this demand can be accommodated in the co-ordination process without impacting availability of locations for low-power licences ▪ Given the medium-power licence authorises base stations individually, there could be merit in considering if more than one medium-power base station can be permitted in a single authorisation in one location (for example, to optimise coverage across a larger industrial area, if connectivity is needed between buildings) ▪ Costs/benefits of allowing power levels higher than the current medium-power limit, for selected use cases and in very rural locations (such as FWA), could be considered
Co-ordination process for different forms of antenna deployment	▪ Ofcom currently specifies maximum base station power as EIRP per sector whereas there could be support from some equipment suppliers to consider how to modify the co-ordination criteria for base stations to use active antenna systems (AAS) ▪ The current co-ordination process uses EIRP for co-ordination, but it could be beneficial to consider using specific antenna characteristics in the co-ordination process – for example, applicants might be able to demonstrate co-ordination is possible in a location based on the following: – antenna directivity/antenna patterns, rather than EIRP[1]-based co-ordination – antenna down-tilting – AAS, for which a coverage radius for the base station might be stipulated to define the AAS beam characteristics
Bandwidth used	▪ The current flexibility on bandwidth requirements, based on multiples of 10MHz bandwidth, seems appropriate, as it provides users with flexibility and ensures some flexibility in accommodating competing demands in a location – given high traffic levels for some use cases, our research suggests most applicants will likely prefer to carry on using a 100MHz channel as today and future applications might require multiples of 100MHz channels (for example, for multiple live video streams or AR/VR applications)

[1] EIRP: effective isotropic radiated power

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There is benefit in reducing application timescales to meet current and future use case requirements, and in making the co-ordination process more visible

- We think key priorities for the licensing process are to reduce application timescales, and to give more visibility of the co-ordination process
- With a view to reducing application timescales, **putting the application process online** seems to be an immediate priority
- Various approaches could also be considered to increase visibility of the assignment process and give some indication of likelihood of success – for example:
  - identify a single point of contact within Ofcom for SAL applications
  - create user accounts so that information on organisations who are regularly applying for SALs, or hold multiple licences in different locations is easily accessible both to the organisation, and to Ofcom
  - provide transparency to applicants concerning the co-ordination process including the current 'exceptions process' (for processing of applications that depart from the standard conditions)
  - consider if high-level information on current SAL locations and frequencies can be made more accessible to aid applicants when assessing if a location is likely to be viable
- With regards to evolution of the licensing approach, our conclusion is the current **Ofcom-managed process for granting of individual licences for requested locations seems suitable to address current and future use cases** requiring customised licences in terms of geographic area/bandwidth
- Whilst noting that some parties are expressing a desire for opportunistic access to spectrum via design of a dynamic spectrum access (DSA) solution, our conclusion is that the current Ofcom-managed co-ordination process for granting of individual licences appears suitable to address use cases requiring customised licences for specific locations and bandwidths
  - we note that a DSA process with geolocation and sensing (e.g. like USA CBRS[1]) would rely on radio equipment being designed to communicate with DSA database solutions and sense the local environment, which is not the situation in the current 5G ecosystem
  - most of the use cases rely on a certain level of quality of service and guaranteed access to the spectrum when in use
    - as a result, spectrum downtime will be limited, hence it will reduce the possibility of opportunistic access to the spectrum

[1] CBRS: Citizens Broadband Radio Service

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We have developed a number of recommendations to improve the SAL framework, which have been assigned a priority rating

Summary of improvement suggestions to the SAL framework

No.	Recommendations	Priority
1	Seek to increase rate of licence application granting and make the process more visible (such as by putting the application process online, earlier indication of chances of applications being approved for given locations and reducing timescales between application and approval). Appoint a single point of contact at Ofcom for licensing queries relating to SALs	High
2	Consider whether a high-level summary of existing low- and medium-power assignments can be made visible to applicants through an easy-to-view interface, to give greater visibility over availability of spectrum at given locations (such as via a map showing the location of currently approved licences)	High
3	Provide an online indication (e.g. yes/no/subject to further co-ordination) as to the status of applications, to give an idea to applicants of likelihood of applicant being approved	High
4	Include details of antenna pattern in the technical details requested from applicants so that directionality of antenna radiation can be incorporated into the co-ordination process	High
5	Consider clarifying technical conditions to enable use of AAS under the current medium-power licence	High
6	Improve the visibility of the 'exceptions process' (i.e. the co-ordination process undertaken by Ofcom to consider applications that depart from the standard conditions). Greater transparency to applicants on timescales for the process, and better dialogue over mitigation factors that might improve the success of co-ordination (e.g. antenna directivity, change in location, down-tilting, etc.) could be beneficial	High
7	Consider if medium-power licences can be applied for in some/selected non-rural postcode areas (once patterns of demand are clearer and Ofcom has a greater understanding of likely spectrum demand based on numbers and types of licences applied for to date)	Medium
8	Give flexibility to applicants to apply to use more than one base station in deployments at a given location under a medium power licence (e.g. to provide coverage between buildings in a larger site)	Medium
9	Offer more flexible short-term licence durations for content production deployments and update the fee structure accordingly for shorter-duration licences to encourage efficient use of the spectrum	Low
10	Examine how to maintain a level playing field for multiple applicants applying for a SAL to respond to the same customer need (e.g.in response to a customer who has issued a request for proposals via a competitive tender). Consider adding 'customer name' to the application so that Ofcom is able to identify where multiple applicants are applying for spectrum to respond to the same customer	Low
11	Continue to allow applicants to resolve co-ordination issues locally through suitable market means, such as synchronisation of TDD[1] timing using GPS[2]	Low

 [1] TDD: time division duplex; [2] GPS: global positioning system

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Contact details

Janette Stewart

Partner

janette.stewart@analysysmason.com

Luwen Meng

Consultant

luwen.meng@analysysmason.com

Bonn
Tel: +49 228 3876 9474
bonn@analysysmason.com

Cambridge
Tel: +44 (0)1223 460600
cambridge@analysysmason.com

Dubai
Tel: +971 (0)4 446 7473
dubai@analysysmason.com

Dublin
Tel: +353 (0)1 602 4755
dublin@analysysmason.com

Hong Kong
hongkong@analysysmason.com

Kolkata
Tel: +91 33 4084 5700
kolkata@analysysmason.com

London
Tel: +44 (0)20 7395 9000
london@analysysmason.com

Lund
Tel: +46 8 587 120 00
lund@analysysmason.com

Madrid
Tel: +34 91 399 5016
madrid@analysysmason.com

Manchester
Tel: +44 (0)161 877 7808
manchester@analysysmason.com

Milan
Tel: +39 02 76 31 88 34
milan@analysysmason.com

New Delhi
Tel: +91 124 4501860
newdelhi@analysysmason.com

New York
Tel: +1 212 944 5100
newyork@analysysmason.com

Oslo
Tel: +47 905 59 075
oslo@analysysmason.com

Paris
Tel: +33 (0)1 72 71 96 96
paris@analysysmason.com

Singapore
Tel: +65 6493 6038
singapore@analysysmason.com

Stockholm
Tel: +46 8 587 120 00
stockholm@analysysmason.com