

Licensed shared access

A report for the UK Spectrum Policy Forum

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uk spectrum policy forum

About the UK Spectrum Policy Forum

Launched at the request of Government, the UK Spectrum Policy Forum is the industry sounding board to Government and Ofcom on future spectrum management and regulatory policy with a view to maximising the benefits of spectrum for the UK. **The Forum is open to all organisations with an interest in using spectrum** and already has over 150 member organisations. A Steering Board performs the important function of ensuring the proper prioritisation and resourcing of our work.

The current members of the Steering Board are:

Airbus Defence and Space
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QinetiQ
Qualcomm
Real Wireless
Sky
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About techUK

techUK facilitates the UK Spectrum Policy Forum. It represents the companies and technologies that are defining today the world we will live in tomorrow. More than 850 companies are members of techUK. Collectively they employ approximately 700,000 people, about half of all tech sector jobs in the UK. These companies range from leading FTSE 100 companies to new innovative start-ups.

About Plum

Plum offers strategic, policy, regulatory and technical advice on matters relating to the use of spectrum and to the telecommunications, online and audio-visual media sectors. A London-based partnership founded in 2007, it works for governments, regulators, service providers and equipment suppliers around the world. Its advice is based on economic analysis and technical knowledge of radio engineering, which it combines with extensive market knowledge of the communications sectors to provide clear and sound analysis.

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1 Introduction

techUK, on behalf of the UK Spectrum Policy Forum (SPF), commissioned this study on spectrum sharing and Licensed Shared Access (LSA) to make proposals for the most acceptable specification for LSA for the UK. The study considers the four points below and makes recommendations based on the outcome of Plum's research into LSA, information available from the European Commission workshop that took place in Brussels¹, UK Spectrum Policy Forum Cluster 2 meetings and the outcome of stakeholder interviews.

The four points are:

- An overview of the motivation for sharing focussing on LSA.
- A discussion of the currently proposed formats for LSA.
- An evaluation of the relative merits of the current proposed approaches.
- A summary of stakeholder views on LSA and the issues foreseen with implementation.

For the stakeholder interviews Plum, via the SPF, approached a number of stakeholders from a cross section of spectrum users in the UK. Policy and regulatory input was obtained from interviews with the DCMS and Ofcom. The list of interviewees and other contributors is at Appendix A.

1.1 Current sharing of spectrum in the UK

There are already successful spectrum sharing models in the UK. Examples include:

- Static sharing (e.g. sharing of satellite and fixed link services in 3.6-4.2 GHz).
- Programme Making and Special Events (PMSE).
- Sharing of defence and emergency services.

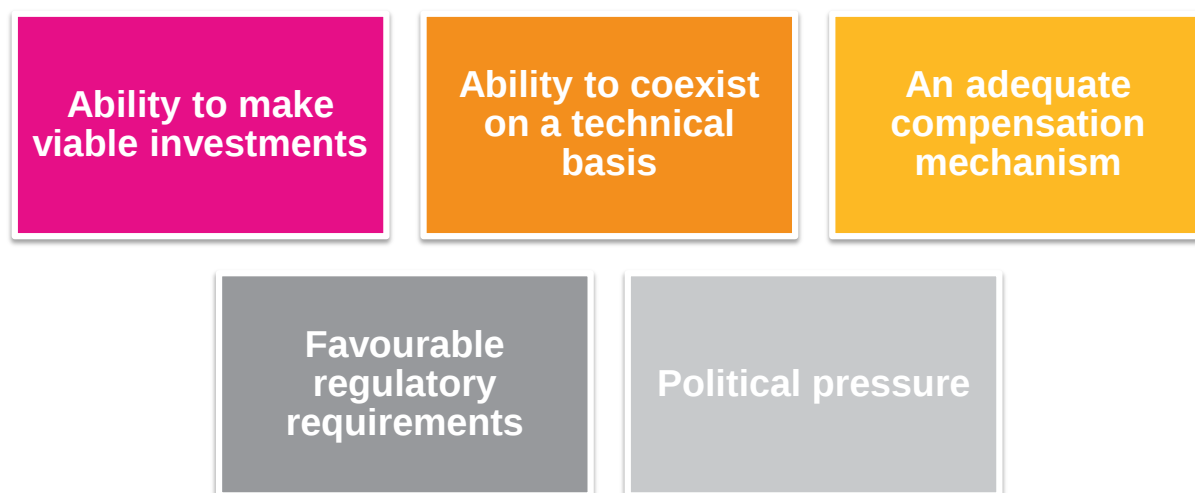
In addition there is the use of licence exempt bands for Wi-Fi and other services.

In general these models work well. Recent work on spectrum sharing has looked at more flexible / dynamic modes of sharing, some utilising database / repository and sensing techniques. These models will become more important as demand for spectrum grows.

There are a number of factors necessary for successful sharing of spectrum. These are shown in Figure 1-1.

¹ EC Workshop on Geolocation Databases – Brussels, March 20th, 2015

Figure 1-1: Factors for successful sharing



1.2 Future demand for spectrum and spectrum sharing

Innovation in communications and other wireless technologies creates more demand for spectrum. As demand grows the pressure for more efficient spectrum use increases as it becomes harder to find clear spectrum to allocate to services. This is particularly true for those bands which are sought after for more than one use/application, especially for spectrum below 6 GHz (i.e. “sweet spots”).

The UK Spectrum Strategy² highlights the need to increase spectrum sharing in the UK to meet future demand. Sharing could involve both commercial and public sector spectrum.

Ofcom’s April 2014 Statement on spectrum sharing³ focused on Wi-Fi and Dynamic Spectrum Access (DSA) but it did not explicitly consider LSA other than its application to the 2.3 GHz band and possibly other bands in future.

Ofcom is again consulting on spectrum sharing⁴. Ofcom states its intention to consider sharing options systematically when defining new spectrum authorisation and when seeking to identify spectrum to meet new demands. It is attempting to define a framework that is applicable to any spectrum band but it is not setting out to enforce sharing in every band. The framework will consider:

- Barriers: what limits the extent of current or future sharing?
- Tools and enablers: what will help to facilitate sharing?
- Characteristics of use: what needs to be taken into account for both incumbents and new users?

² https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/287994/UK_Spectrum_Strategy_FINAL.pdf

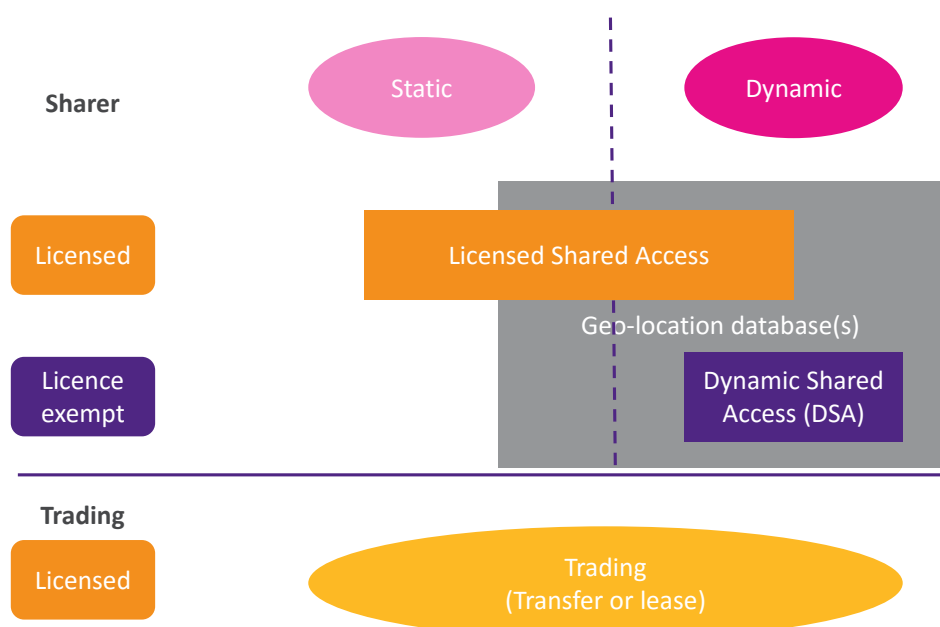
³ http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum-sharing/statement/spectrum_sharing.pdf

⁴ <http://stakeholders.ofcom.org.uk/binaries/consultations/spectrum-sharing-framework/summary/spectrum-sharing-framework.pdf>

When discussing LSA Ofcom clearly states in its latest consultation that the UK already facilitates sharing between multiple uses under the WT Act⁵. The implication of this is that Ofcom do not see changes being required to the UK licensing regime for LSA like sharing.

Figure 1-2 shows Plum's view of different sharing mechanisms and the applicability of DSA and LSA. The figure also shows spectrum trading. While trading can create similar outcomes to sharing it is not the same. In a trade the spectrum and all rights are either transferred to a new licensee or under a lease arrangement the rights remain with the existing licensee and a contract handles the relationship between the licensee and the lease holder. This is different to LSA where both the incumbent and sharer would be using directly licensed spectrum⁶. The long term evolution of LSA could be towards more dynamic forms of sharing.

Figure 1-2: Sharing mechanisms and spectrum trading



Source: Plum Consulting

It should be noted that while a role is seen for LSA for some spectrum using applications (e.g. mobile, PMSE) several of the stakeholders we interviewed also felt that there is a role for DSA and that in the long run innovation could drive a lot of licence exempt sharing, especially in the machine to machine sector.

1.3 Licensed Shared Access (LSA)

LSA was conceived as a means of providing access to licensed bands that otherwise would not be possible in some European countries. The key features of LSA are that it is voluntary, licensed and exclusive. A LSA licensee is granted exclusive use of the spectrum at a given time and location that is

⁵ See paragraph 5.43 of the consultation

⁶ The sharer will have its own spectrum licence on terms which are agreed with the incumbent (and regulator)

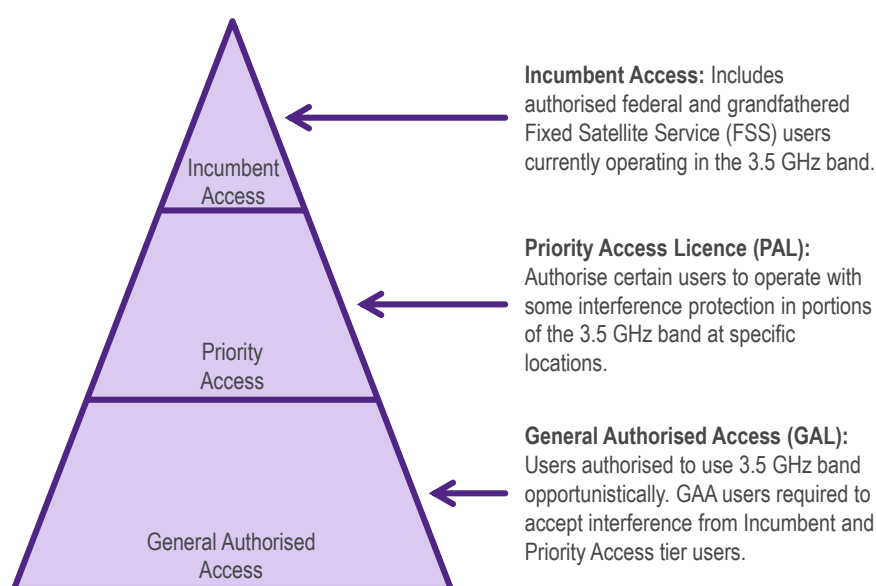
likely to be long term. LSA also provides protection to the incumbent and its use of spectrum. LSA changes the traditional approach to sharing in that it is based on enhancing economic and social value rather than being based on a first in time or similar hierarchical rule. A considerable amount of definition and standards work has taken place on LSA in Europe and the concept is now being put into practice with the advent of trials. LSA is described more fully in Section 2.

1.4 Other approaches to sharing

Administrations outside of Europe are developing new approaches to sharing including the United States as described below.

The United States is developing an approach to sharing in the 3.5 GHz band as shown in Figure 1-3. This three layer model is based on different parameters for incumbent access, priority access and general authorised access – incumbents having the most protection and general authorised access the least. The scheme is covered in FCC Rule Making FCC 15-47⁷. The scheme operates in the spectrum range 3550-3700 MHz and it primarily aimed at enabling the use of small cell technology.

Figure 1-3: US 3.5 GHz sharing



Source: FCC, Plum

⁷ https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-47A1.pdf

2 Licensed Shared Access (LSA)

2.1 LSA development

LSA was conceived as a means of providing access to licensed bands that otherwise would not be possible in some European countries. Much of the work on LSA to date has been for the 2.3 GHz band where LSA will be used to create sufficient scale for deployment of mobile services in the band across Europe. Table 2-1 taken from a previous Plum study on the 2.3 GHz band shows how the use of LSA increases the effective population coverage achieved by the band⁸.

Table 2-1: Opening the 2.3 GHz band with LSA

Parameter	2015	2020	2025	2030
Equivalent population coverage <u>with</u> LSA	71%	83%	84%	84%
Equivalent population coverage <u>without</u> LSA ⁹	1%	17%	17%	17%

Definition of LSA has taken place in CEPT and ETSI. ECC Report 205¹⁰ sets out the sharing framework for LSA based on the RSPG definition of LSA¹¹. ETSI is working on a functional interface design for LSA network elements.

LSA is being worked on in a number of European countries:

- France – The ANFR and Ministry of Defence plan to carry out trials of LSA in the 2.3 GHz band in the second half of 2015. The sharing service will be mobile.
- Finland – A live spectrum sharing trial has been established to demonstrate LSA in the 2.3 GHz band. The services are mobile and PMSE.
- Italy – The Ministry of Economic Development has launched a pilot project to test the use of shared spectrum based on LSA in the 2.3 GHz band. The sharing service will be mobile.
- The Netherlands – The Radio Communications Agency will be running a trial later in 2015 of PMSE sharing with mobile in the 2.3 GHz band.

In May 2015 CEPT announced a new work item “to share experience on LSA implementation and testing (e.g. measurement results) by NRAs.”¹² The work item was supported by France, the Netherlands, Russia, Finland and Estonia. There is also an ECC PT1 work item on the methodology

⁸ The economic benefits of LSA in 2.3 GHz in Europe. Plum December 2013. Countries covered in the study were Finland, France, Ireland, Italy, Sweden and the UK. Equivalent population coverage is population coverage that takes into account the amount of time that the spectrum is available for use in the coverage area. For instance, if the spectrum is shared with PMSE incumbents, who need the spectrum 10% of the time on an exclusive basis across the country, and the population coverage of the spectrum is 100%, then the equivalent population coverage is 90% of the time x 100% of population = 90%.

⁹ A few relatively small countries (e.g. Ireland and Sweden) have plans to release the entire band in the absence of LSA.

¹⁰ <http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP205.PDF>

¹¹ RSPG Opinion on Licensed Shared Access. RSPG13-538 November 2013

¹² CEPT Working Group Frequency Management, ‘New Work Item on LSA (FM_33)’, FM(15)173 Annex 11, May 2015
<http://www.cept.org/ecc/groups/ecc/wg-fm/client/meeting-documents>

for establishing national frameworks for spectrum sharing between mobile/fixed communication networks and existing satellite and fixed link services in the 3.6 – 3.8 GHz band¹³. It is expected that this sharing will be facilitated by LSA.

In the UK an LSA-type approach could be considered to expand the amount of spectrum for mobile in the 2.3 GHz band in the longer term.

2.2 Definition of LSA

LSA allows licensed services to share spectrum in a band. In November 2013 the RSPG published its 'Opinion on Licensed Shared Access which defined LSA as:

“A regulatory approach aiming to facilitate the introduction of radiocommunication systems operated by a limited number of licensees under an individual licensing regime in a frequency band already assigned or expected to be assigned to one or more incumbent users. Under the Licensed Shared Access (LSA) approach, the additional users are authorised to use the spectrum (or part of the spectrum) in accordance with sharing rules included in their rights of use of spectrum, thereby allowing all the authorized users, including incumbents, to provide a certain Quality of Service”.

The justification for LSA was that:

“LSA offers an alternative for the incumbent to release a frequency band targeted by new users whilst keeping guarantees for maintaining its uses in the long term, thus contributing to the overall objectives of efficient use of the spectrum.”

The key features of LSA are:

- Voluntary: the goal of LSA is to make available additional spectrum resource in specific bands used by incumbent applications through enabling more advanced sharing than is possible through existing regulatory mechanisms. Sharing through LSA requires close cooperation between the incumbent and the LSA licensee and should therefore be implemented on a voluntary basis.
- Licensed: access to incumbent's spectrum as part of a “sharing framework” can be understood as a set of sharing rules or sharing conditions that will materialise the change, if any, in the spectrum rights of the incumbent and define the spectrum, with corresponding technical and operational conditions, that can be made available for alternative usage under LSA. The “sharing framework” will be the responsibility of the Administration/NRA who will also be responsible for issuing a licence to the LSA Licensee following a procedure that is compliant with the Authorisation Directive.
- Exclusivity: The new LSA licensee is granted an exclusive use of the spectrum resource at a given time and location that is likely to be long term.
- The administration/NRA might manage an LSA repository, containing the relevant information on LSA spectrum that must be protected together with the level of protection provided by the incumbent.

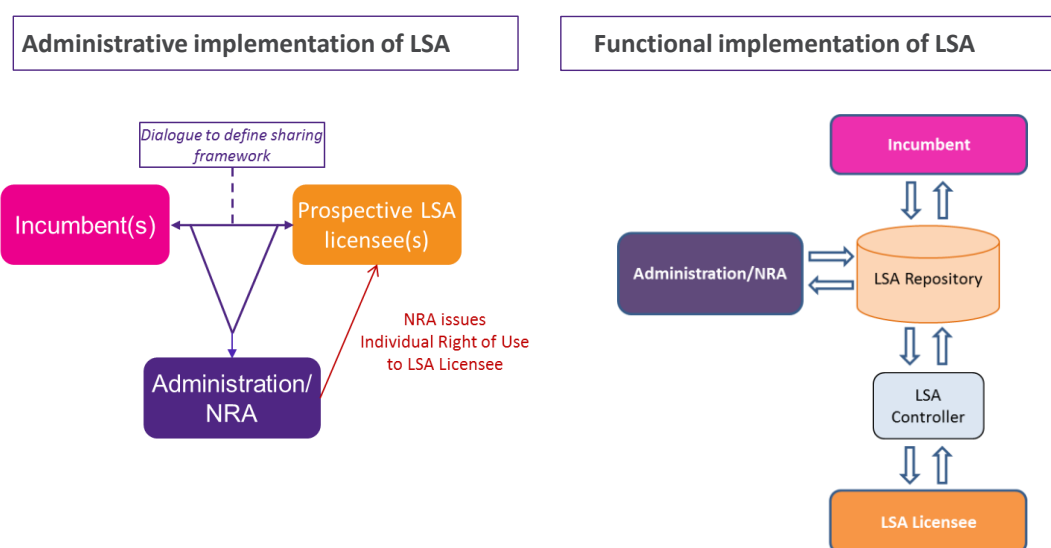
¹³ ECC PT1(15)058

The intention is that LSA will support licensed shared services in a band. LSA introduces the possibility of handling dynamic sharing and the possibility of coupling economic compensation with the degree of sharing.

2.3 Administrative and functional implementation of LSA

Figure 2-1 shows the administrative and functional implementation of LSA.

Figure 2-1: Administrative and functional implementation of LSA



Source: ECC Report 205

Setting up an LSA arrangement involves three parties: the incumbent, the sharer(s) and the National Regulatory Authority (NRA).

- The incumbent user will have its rights to spectrum formalised or licensed during the process of establishing the sharing arrangement. The incumbent must adhere to the terms and conditions of its licence / access rights.
- New users (sharers) are granted exclusive licences that are likely to be long term. The new user(s) must adhere to their licence conditions.

The role of the regulator is to facilitate engagement between the incumbent and new user, issue new licences and provide/control a repository.

Compensation arrangements may be involved in the sharing arrangement – the incumbent user may receive compensation for costs incurred implementing sharing¹⁴. The sharer is likely to pay a licence fee of some sort or to gain access to spectrum, possibly through an award mechanism.

¹⁴ These costs could include costs associated with administration, changing equipment, modifying spectrum software and databases. These may be paid directly by new users or come from government revenues.

2.4 Incentives and competition

The RSPG set out its view on incentives for LSA as follows.

“Balancing the impact on the incumbent and the usage constraints on any additional user is a challenge. Administrations, when examining socio-economic benefits would inter alia need to take into account (i) the conditions under which existing assignments were made, including costs incurred, and (ii) the legitimate expectations of the incumbent as well as LSA users.”

In reality incumbent users will only be willing to share if they see some benefit from the arrangements. These benefits might include, for example:

- Direct payments from the new user or the regulator (assuming no state aid issues in a European context). Payments to upgrade equipment or take other costly actions than would facilitate sharing¹⁵.
- Savings on fees paid to the regulator for underused spectrum.
- The security of tenure and greater certainty about the interference environment that comes through formalisation of its access rights (and their enforcement) or access to services provided by the new user.

However, incentives and sharing arrangements must be set such that there is not an adverse impact on competition.

Incentives for the sharer include:

- Certainty of access
- Quality of service
- Opportunity to make a return on investment in the band.

¹⁵ These payments might be made by the new user or possibly even central government in the case of a government user

3 Stakeholder interviews

Fourteen stakeholder interviews were carried out for the study. Written input was also received from some stakeholders. We are also grateful to the many people who spoke informally to us at various SPF meetings. A full list of interviewees and contributors can be found at Appendix A. A list of questions for stakeholders was agreed in discussion with techUK as shown below:

- **Characteristics of LSA.** Does LSA as currently described contain the features stakeholders see as necessary for sharing?
- **LSA format.** Is LSA as it is currently defined feasible?
- **Incentives to share.** What incentives are necessary for sharing?
- **Spectrum.** What frequency bands could be possible?
- **Coexistence criteria.** How should protection/exclusion zones be approached to deliver QOS expectations?
- **The future.** How should the future plans of spectrum users be handled with LSA?
- **Licences.** What do LSA licences need to look like?
- **Spectrum pricing and fees.** How should spectrum be priced for LSA?
- **Enforcement.** Is there anything that needs to change for LSA?

3.1 Summary of responses

In general there was consensus among stakeholders regarding the technical, economic and regulatory aspects of LSA. This is summarised in Table 3-1. A common theme was that one size does not fit all – many different sharing arrangements could be possible in different bands. Therefore stakeholders believed that a generic, adaptable framework is required for LSA (and sharing in general) based on a set of consistent principles. At present it is unclear if Ofcom can create a framework to support LSA without there being additional legislation in place¹⁶. Also, the responses indicated the need for a higher level of engagement between industry and those shaping the regulatory/policy framework for sharing.

Table 3-1: Summary points

Summary points
Spectrum sharing is not new to the UK. It was repeatedly emphasised how spectrum sharing has successful precedent in the UK.
LSA does not require a new regulatory framework in the UK. While there may need to be some clarifications stakeholders, including DCMS and Ofcom, believe Ofcom already has the powers to regulate sharing, including LSA.
LSA is not seen as a priority for the UK for the present. There was agreement among stakeholders that LSA has the potential to provide more opportunity for access to spectrum and to increase spectrum efficiency, but many interviewees hadn't considered use of LSA in detail.

¹⁶ There is one known issue for licensing a geo-location database that would be operated by Ofcom. At present this activity is provided by a contracted third party who can be licensed

Summary points

LSA must be voluntary. Stakeholders on both the supply and demand sides of the market agreed that LSA agreements had to be voluntary for both the sharer and the incumbent. There was no appetite from any stakeholder for mandating incumbent spectrum holders to share their spectrum using LSA.

LSA should be brokered in private agreements. The LSA model desired by stakeholders is one where sharing agreements are initiated and set by private parties.

A limited role for the regulator. There was agreement among stakeholders that Ofcom has a limited role to play in the setting up of LSA agreements, other than issuing licences in accordance with the agreed sharing agreements and arbitrating disputes. However, Ofcom has a key role to play in the creation of a positive sharing environment and the removal of barriers to sharing (see Section 5.2).

Geographical sharing is seen as more feasible than time sharing. Stakeholders typically viewed time based sharing as too complex and not meeting their needs for protection. Stakeholders are more comfortable with geographic sharing based on experience of setting geographic coordination and exclusion zones.

Simplicity is essential. There was general agreement that over-complex processes and systems should be avoided. For example, LSA could be done on paper in some cases (although such sharing arrangements might be better categorised as static sharing).

While stakeholders said they were supportive of LSA it was evident that there is a lack of knowledge of the detail. Some stakeholders seemed unaware of the ability of the UK WT Act regime to support LSA type arrangements. Also many of the views expressed by stakeholders were consistent with a static sharing framework and hence fairly conservative. It is possible looking 10 years into the future that more “ambitious” sharing scenarios will need to be considered and this is where LSA could play a role for spectrum using services that require specified quality of service.

3.2 The nature of LSA

Table 3-2 summarises the responses from stakeholders on the nature of LSA.

Table 3-2:

	Stakeholder view
Voluntary approach	The framework preferred by stakeholders was mostly one of private contractual arrangements. Note that there were different considerations for commercial and public sector holders of spectrum: • In the case of commercial sharing the arrangement may simply require the issuing of new WT Act licences by Ofcom to reflect the sharing arrangements agreed between the incumbent and sharer. • In the public sector case there are a number of issues around the provision of RSA for spectrum to be shared, the conversion of RSA into a WT Act licence and the financial aspects of the sharing arrangement, all of which require greater clarity.
Incentives	The incentives model imagined by most stakeholders is that the payment from the sharer to the incumbent does not flow through Ofcom. However stakeholders do see an administrative fee being paid to Ofcom for WT Act licensing. This becomes more complex when considering sharing of public sector spectrum, especially the ability of public sector spectrum holders to receive one off payments and/or income for providing shared access to their spectrum.

	Stakeholder view
Co-existence – quality of service	In a LSA environment establishing coexistence criteria and management of interference is viewed by stakeholders as being of critical importance. Coexistence criteria depend on the specific applications that are sharing the spectrum. Stakeholders expressed a view that coexistence in a LSA environment should be based on relatively conservative parameters. Stakeholders expressed some scepticism on the ability to manage interference in a dynamic environment. Stakeholders also highlighted that better records will be required to manage coexistence in a LSA environment. There was concern among stakeholders about how coexistence criteria would be built into licences for LSA.
Spectrum bands	Stakeholders expressed different opinions on this aspect. • Low or high frequencies? Propagation characteristics will impact coexistence criteria. Lower frequencies were seen as less likely to be suitable for sharing. • Harmonised or un-harmonised spectrum? LSA is seen as a vehicle for mobile services to gain access to more spectrum¹⁷. Some stakeholders felt that LSA should not be limited to harmonised spectrum as there is also demand for spectrum that is not harmonised¹⁸.
Licence duration	Stakeholders had a variety of views on this aspects. The length of sharing agreements will vary as the incumbent's need for flexibility is balanced against the sharer's need for certainty. Thus the licence duration would vary from sharing agreement to sharing agreement. The value of the sharing arrangement to the sharer will increase with licence duration. Longer certainty of usage rights gives the sharer more opportunity to make a return on the investment of paying for the spectrum rights and the equipment to use the spectrum. Also, the amount flexibility an incumbent would have regarding ending an agreement is important to some stakeholders. A LSA agreement would need to detail the notice period and what happens when notice is served, both in terms of practicalities and compensation.

¹⁷ ECC Report 205, for example, views LSA primarily as a means of increasing the amount of spectrum available for mobile usage: *"The first practical use case of LSA will be to provide access to additional spectrum for mobile broadband services"* (p.30). Similarly, Ofcom's 2014 spectrum sharing statement states that LSA bands *"should be internationally harmonised or have a realistic prospect of harmonisation in the short to medium term"* and that *"the frequency and propagation characteristics of the spectrum band should be favourable for use by mobile broadband"* (p.25).

¹⁸ For example, the utility companies would be willing to use shared spectrum in bands that are not harmonised

	Stakeholder view
Enforcement	The issue of enforcement elicited opinions from all stakeholders. There are two potential types of enforcement issue that would be handled by Ofcom: • Between the incumbent and the sharer. This may require an arbitration mechanism if they cannot sort it out for themselves. • Between the incumbent or sharer and a third party. Ofcom would deal with this in the same way as it currently deals with an interference case. Stakeholders do not foresee the need for extra powers for Ofcom for enforcement in a LSA environment. However, stakeholders believe Ofcom would need to be responsive (i.e. have the resources available) where its intervention is required.
Transparency	Stakeholders saw this as potentially the most significant blockage to sharing in general including LSA in the UK. It is the lack of information around the supply and demand sides of the spectrum market: those who demand more spectrum are unaware of where there is idle spectrum, while those holding idle spectrum are unaware of those who might be willing to pay to share it. As a result it is hard for a marketplace to develop. This is seen, for example, in the low quantity of spectrum trades in the UK. While there are no easy solutions policy makers need to deal with the transparency problem if they are to encourage spectrum sharing.

Two other issues were raised by stakeholders that may need to be considered when thinking about sharing agreements:

- Data security. The incumbent may not wish its usage of spectrum to become public knowledge as it may be commercially or otherwise sensitive information¹⁹.
- Incumbents may be unwilling to share if the sharer is a direct competitor in a retail market downstream. While this may be the case, sharing between applications is unlikely to present this issue (as there are typically different retail markets)²⁰.

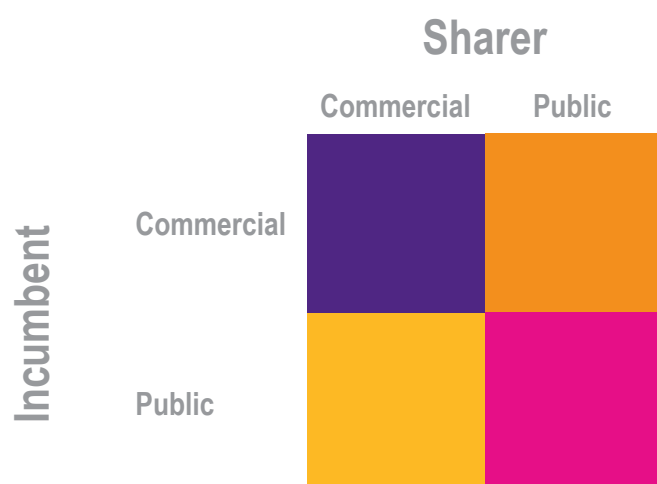
¹⁹ A WT Act licence would be a public document.

²⁰ ECC Report 205 makes similar observations and concludes: “*The sharing framework has therefore limited impact – likely no impact – on the market regulation policy objectives since incumbent and LSA licensees belong to two different vertical markets.*” (p.20)

4 Public sector sharing

One of the major items to arise in the stakeholder interviews and at the UK Spectrum Policy Forum in general is the issues that arise with the public sector sharing spectrum. In theory the public sector could be the incumbent or the sharer, as shown in Figure 4-1, but it is likely that for the most part the public sector will be the incumbent spectrum user.

Figure 4-1: Public and private sector sharing combinations



The Ministry of Defence (MOD) is the largest holder of public sector spectrum and it is seen as the most likely sharing incumbent in the UK.²¹ Therefore any LSA framework needs to deal with potential road blocks to the MOD sharing spectrum as a matter of priority. The scope for spectrum sharing with defence can be seen in the USA where the Department of Defence views spectrum sharing as a priority²² and will share the 3.5 – 3.7 GHz band with commercial users using a tiered sharing arrangement.²³

Three issues arose when talking to stakeholder in relation to the public sector sharing spectrum:

- Are public sector spectrum users technically able to share spectrum?
- Are public sector spectrum users legally able to share spectrum?
- Are public sector spectrum users incentivised to share spectrum?

²¹ This was affirmed by all the relevant stakeholders.

²² Department of Defence, "Electromagnetic spectrum strategy 2013", September 2013

<http://www.defense.gov/news/dodspectrumstrategy.pdf>

²³ FCC, 'Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz band', Report and Order and Second Further Notice of Proposed Rulemaking, 21st April 2015

https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-47A1.pdf

4.1 Are public sector spectrum users technically able to share spectrum?

Stakeholders believed there is spectrum held by the public sector that could be shared without reducing operational capacity, either on a geographic or time basis. The fact that government departments already share shows that there is some technical knowledge of sharing.

There were, however, three technical issues raised in the stakeholder interviews that need to be addressed for the public sector to be fully able to share spectrum:

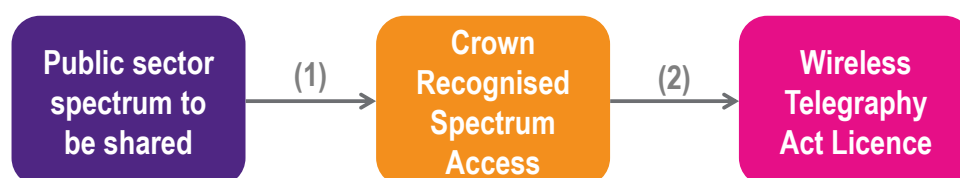
- Incumbents need to know their own spectrum usage. In some cases there is a lack of transparency to public sector spectrum managers about which spectrum their departments actually use. This situation could be improved with a comprehensive spectrum inventory across the public sector.
- Sharing requires technical coexistence studies to be carried out. Stakeholders highlighted that there is an issue over which party pays for these technical studies and obtaining the technical parameters that should be applied.
- Sharing may involve public sector users moving their usage to different bands, optimising usage or deploying spectrum agile equipment. There is a cost to these measures which needs to be faced in order to realise the long term benefits of sharing. Stakeholders stated that covering these costs is a crucial part of offering attractive incentives to the public sector.

4.2 Are public sector spectrum users legally able to share spectrum?

Many public sector spectrum users do not hold Wireless Telegraphy Act licences – they function using authorisation managed by government departments (rather than Ofcom).

The first step for such spectrum to be shared (especially with commercial users) would be the application of Recognised Spectrum Access (Crown RSA). For commercial sharing the Crown RSA would then be “converted” to a WT Act licence.

Figure 4-2: Converting public sector spectrum rights



It is understood from the stakeholder interviews that there are issues with the use of Crown RSA and the conversion to WT Act Licences. However, it is not entirely clear what the issues are that need to be addressed and more detailed work would be required to establish this. It was acknowledged by stakeholders that this is currently a complex issue and that the opportunity to simplify it should be considered.

4.3 Are public sector spectrum users incentivised to share spectrum?

The incentives for a public sector incumbent are different from those of a commercial entity. There are three types of incentive that a public sector incumbent could face:

- Payment from the sharer.
- Money flow within Government. For example, reduced AIP fees.
- Non-pecuniary. For example, meeting Government targets for spectrum release.

The key question regarding the payment from the sharer is to whom is the payment made – the incumbent or central government? This policy decision may be complicated by the monies a government department is permitted to receive (i.e. capital receipts or annualised fees). The lack of transparency of intra-governmental budgetary flows may reduce the incentives for individual government departments to share their spectrum.

Incentives could be realised by changes to AIP (administrative incentive pricing). In principle, AIP fees are based on the opportunity cost of the band and are charged on most, but not all, public sector spectrum. In practice, AIP fees are generally not transparent to those outside of the public sector²⁴ and appear not to be regularly updated.²⁵ AIP alterations may be a real concern to public sector spectrum holders. Introducing sharing into a band may increase the opportunity cost of exclusive use of the band as sharing reveals the value of the band is greater. Policy makers would then face a decision over whether this change in opportunity cost should be reflected in increased AIP fees. There is also a question about whether reduced AIP fees would be an incentive, since at a subsequent spending review any savings are expected to be reclaimed by central government.

However, the stakeholder interviews indicate that reducing AIP nevertheless appears to be a strong incentive for government departments to share spectrum. In the end though, it may be the case that the strongest incentive for the public sector to share spectrum is political rather than pecuniary. The Government target of releasing 500 MHz of spectrum by 2020 may incentivise sharing at the highest level of Government (even if it is not entirely clear how shared spectrum counts towards this target).

4.4 Central Management Unit

In August 2015 the Government published the terms of reference for a new Government body called the Central Management Unit (CMU)²⁶. It is not yet fully clear how the CMU will deal with the issues around public sector spectrum sharing, but the CMU terms of reference give an indication.

The creation of the CMU increases the focus on achieving efficient use of public sector spectrum:

“To centralise the strategic management of public sector radio spectrum in order to better prioritise spectrum management and maximise the economic and social value of spectrum (while maintaining operational effectiveness) by:

²⁴ AIP fees on many bands are not publically available.

²⁵ Some date from the mid-1990s when AIP was first introduced in the UK. Such fees may not reflect the true opportunity cost of spectrum given technological advances.

²⁶ <https://www.gov.uk/government/publications/centralised-management-of-public-sector-spectrum>

- *“Taking better account of spectrum usage across the whole public sector;*
- *“Improving the coordination of spectrum usage across the public sector; and*
- *“Managing public sector spectrum holdings as a national asset, incorporating greater shared use of spectrum and release for commercial use wherever practicable.”*

Also:

“The CMU will be responsible for identifying realistic opportunities to ensure the efficient allocation of public sector spectrum including the release and/or additional sharing of existing allocations in order to generate wider benefits and reviewing new spectrum allocations where required.”

Public sector spectrum users will be responsible to the CMU in regard to releasing spectrum.

Regarding the incentivisation of public sector spectrum users, the CMU appears to have the ability to vary AIP fees. The CMU may raise AIP fees *“on the most valuable bands”* and may lower fees to allow government departments *“to meet the upfront costs of bespoke studies”*. Such studies might include examining potential coexistence between a public sector spectrum user and a possible spectrum sharer.

The CMU has also been tasked with a review of the release target for public sector spectrum and Ofcom is currently undertaking a review of the 500 MHz release target. This review may also clarify how shared spectrum is considered when looking at the release target.

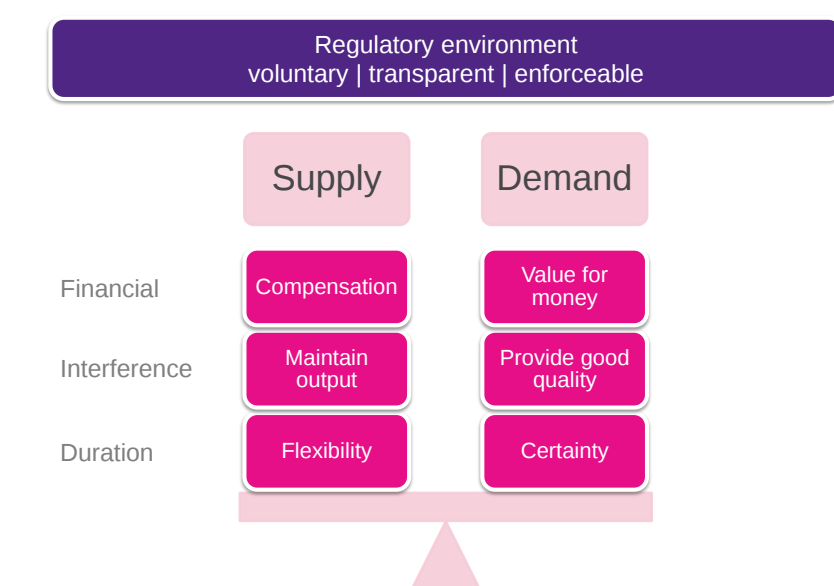
However, it is unclear over what timeframe the CMU will impact spectrum management within the public sector. Industry needs a better understanding of when these changes will occur.

5 Conclusions

We would like to thank all stakeholders for their contribution to this report.

Figure 5-1 provides a summary of the sharing framework for LSA based on the inputs received from stakeholders. As shown, sharing is a matter of matching supply and demand, in particular on three key points: licence duration, interference, and incentives. If the incumbent holders of spectrum rights, be they public or private sector, cannot reach agreed terms with potential sharers of spectrum then LSA will not happen.

Figure 5-1: Sharing framework



5.1 Current proposals

There are currently no proposals for the implementation of LSA in the UK. Ofcom in its current consultation makes clear that the UK already facilitates sharing between multiple uses under the WT Act, which implies that there is not a need for the LSA mechanism in the UK.

It should be noted that the work in Europe on LSA neither constitutes a mandate nor a decision for national regulatory authorities to put LSA in place. There is some uncertainty over whether LSA could become mandated at a European level at some point in the future. In 2013 the RSPG noted that when it comes to the licensing of new bands member states

“could include terms in the licences granted to the incumbent/s in order to facilitate future LSA arrangements with prospective LSA users”

Stakeholders raised concerns about the provisions of the Authorisation Directive and how LSA licences will be awarded in a manner that is fair, transparent and non-discriminatory? This is a matter on which Ofcom would have to respond if it is requested to do so.

5.2 Actions

There are five issues arising from our research where action would seem to be required. These are set out below.

Confirm the UK position on legislation and LSA

Efficient use of spectrum is a key part of spectrum management. As the demand for radio spectrum increases use of sharing is one way to deliver efficient use. All stakeholders questioned in the study agreed with this premise. For spectrum using services where quality, certainty of access and longer duration are required LSA was seen by stakeholders as a preferred mechanism.

Ofcom believe that the current UK WT Act licensing regime will support this requirement. However, many stakeholders did not have a fully developed view of LSA or what the current UK licensing regime will allow as, to date, they have not had to consider it in their strategic and operational planning.

Our first recommendation is that Ofcom confirms that no change is needed to either current legislation (the Wireless Telegraphy Act 2006), or the licensing regime operated under that legislation, for LSA to be implemented in the UK.

Sharing of public sector spectrum

Interviews with stakeholders raised concerns about the feasibility of sharing of public sector spectrum. The concerns centre on three issues:

- Technical ability to share.
- Legal ability to share.
- Incentives to share.

From our interviews it seems there is still a considerable amount of work to do around all three of these. Unless these issues are tackled public sector spectrum holders will be reluctant to share their spectrum outside of the public sector and commercial users will remain cautious.

Our second recommendation is that policy makers consider the scope to simplify the process for sharing arrangements for public sector spectrum. In particular this should include how the use of Crown RSA and incentives such as AIP could be improved so as to encourage public sector users to share.

Information and transparency

For a sharing market to develop there needs to be transparency of spectrum supply and spectrum demand. This was a big concern in our interviews and it was seen as potentially the most significant barrier to sharing in the UK. While there are no easy solutions, policy makers must deal with the transparency problem if they are to facilitate spectrum sharing. Also, while most see LSA as a tool for harmonised bands there is a possible requirement for sharing using an LSA type of arrangement in non-harmonised bands. This requirement was raised by the utilities.

Our third recommendation is that policy makers and industry should look at ways in which greater transparency of spectrum supply and spectrum demand can be achieved.

Coexistence

Coexistence is an essential part of sharing. We heard mainly conservative views on how coexistence should be approached. If co-existence is too conservative it limits the benefit that could be realised through sharing / LSA or indeed in some cases may make it not possible to share. When considering sharing spectrum, incumbents and new users will balance interference with other incentives. Developing a bolder, clear and credible view on coexistence is essential for more widespread sharing to develop.

Our forth recommendation is that Ofcom and industry work toward a bolder approach to interference scenarios for coexistence purposes to maximise the opportunity for sharing

Supporting developments in Europe

The terms of reference refer to making recommendations on the most acceptable specification for LSA for the UK. It should be noted that much work on LSA has already taken place in CEPT and ETSI and that the time has probably passed for influencing the underlying LSA specification²⁷. However, the feedback from this study should be taken into account by Ofcom in its policy and regulation work in Europe.

²⁷ Ofcom has played a role in the work on LSA with its contribution to CEPT and the FM working groups that developed the specification for LSA and on the 2.3 GHz band.

The key areas for action identified in the study in this respect are summarised in Figure 5-2 below. Ofcom has a key role to play in each of the five areas.

Figure 5-2: Key areas for action on LSA in the UK



Appendix A: Interviewees

The following people were interviewed as part of the study. Initial conclusions from the study were presented to the UK Spectrum Policy Forum Cluster 2, the UK Spectrum Policy Forum Steering Board and the July plenary meeting for feedback. Interviewees are listed in Table A-1.

Table A-1: Interviewee list

Organisation	Representative(s)
Arqiva	Anirban Roy, Simon Mason
BT	Chris Cheeseman
Department for Culture Media and Sport	Nick Munn
The defence industry spectrum forum	
Digital 3 and 4	Greg Bensberg
EE	Inge Hansen
Home Office	Ari Toivonen
Joint Radio Committee	Adrian Grilli
Ministry of Defence	Lisa Roper
Ofcom	Rachel Clark
Qualcomm	Luigi Ardito
RED Technologies	Pierre Jean Muller
techUK	Jane Humphreys
Vodafone	Simon Pike, Paul Rosbotham

In addition we received written inputs from Paul Deedman at Inmarsat and Stephen Temple from the 5GIC.