UK DSIT Sandbox

Wireless Innovation Forum

2025 International Spectrum Sharing Workshop

21 May 2025

James (Jody) Neel

Queen Mary University of London

telet

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Content

- About the UK Spectrum Sandboxes
  - Department of Science, Innovation and Technology (DSIT)
- About the QMUL Spectrum Sandbox
  - What problems were we trying to solve?
  - Broadly, how did we solve them?
- How this work leveraged and extended CBRS

- **Message**: CBRS mechanisms are amazingly flexible and extensible for use in other bands and jurisdictions

About DSIT Spectrum Sandboxes and the QMUL Spectrum Sandbox

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DSIT Spectrum Sandboxes

- **DSIT's objective**: Test sharing of spectrum in Ofcom licensed Sandbox environments to indicate how regulation could be improved to maximise the use of this scarce resource and the benefits to the economy.
  - Primarily upper 6 GHz and 3.8-4.2 GHz
- **Project Elements (Work Packages):**
  - WP1: Practical measurements of real wireless networks and testing of new spectrum sharing solutions to establish opportunities for more intensive sharing without harmful interference.
  - WP2: System simulations and modelling to extend the applicability of the measurements and other data sources to other sharing parameters and scenarios, larger-scale network scenarios and differing spectrum management techniques.
  - WP 3: Analysis of economic benefits and costs taking account of the learnings from practical measurements and simulations. A discussion of options for potential regulatory mechanisms and tools that maximise the benefits of shared and hybrid licencing approaches in a spectrum band.
- **Awards (lead organizations)**
  - Real Wireless – 6 GHz Mobile / WIFI sharing via cross-technology sensing
  - University of Durham – distributed sense and avoid, primarily for LAL spectrum
  - **Queen Mary University of London (QMUL) – CBRS extended methods for LAL and SAL spectrum**

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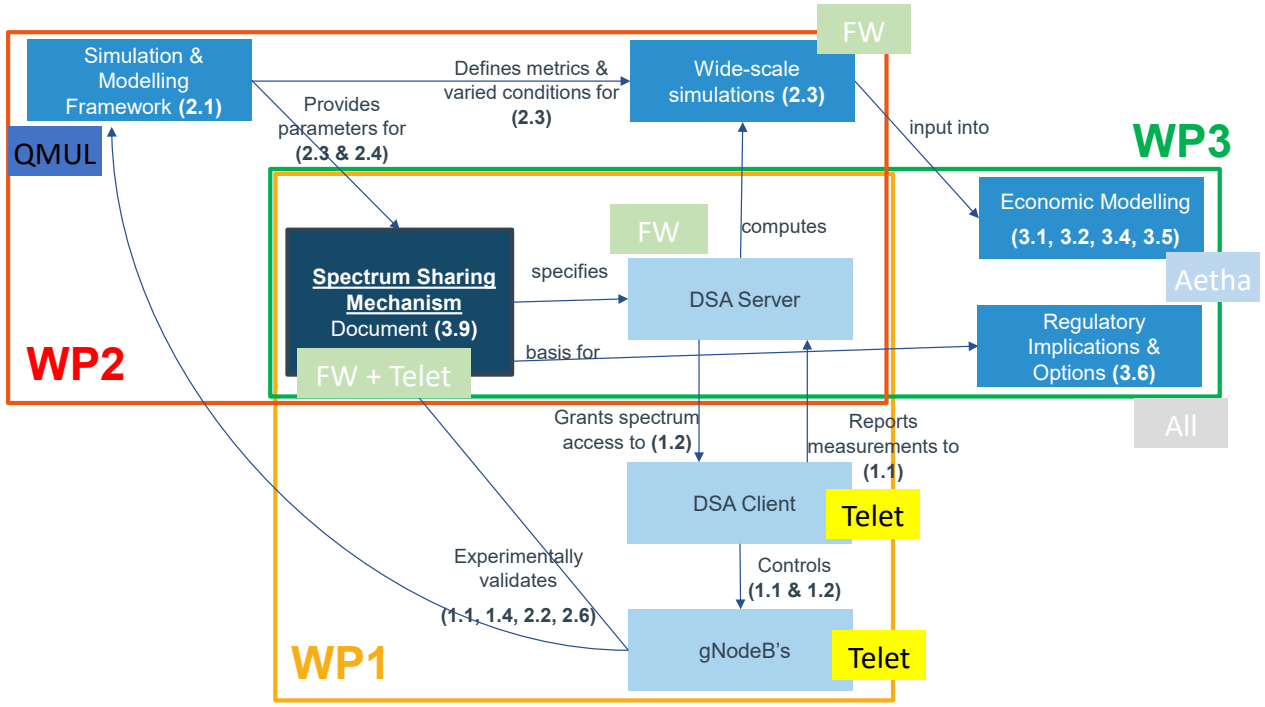
QMUL Spectrum Sandbox Overview

- WP1: Telet, Federated Wireless
  - Prototype a DSA-server based method for **streamlined access** to LAL and SAL spectrum, **increased capacity**, **MNO build-out avoidance**
  - Collect measurements of spectrum occupancy (input to WP2)
- WP2: QMUL, Federated Wireless
  - Simulate 5G links to characterize coexistence parameters (interference thresholds, TDD impact)
  - Assess reduction in propagation uncertainty with ray tracing vs terrain modeling
  - Characterize nationwide spectrum availability
- WP3: Aetha
  - Economic impact modeling and analysis
  - (all) Regulatory implications and recommendations from findings

QMUL Project Organization



Targeted bands for demonstration:

• 1800 MHz	B3	LAL
• 3800-4200 MHz	n77	SAL

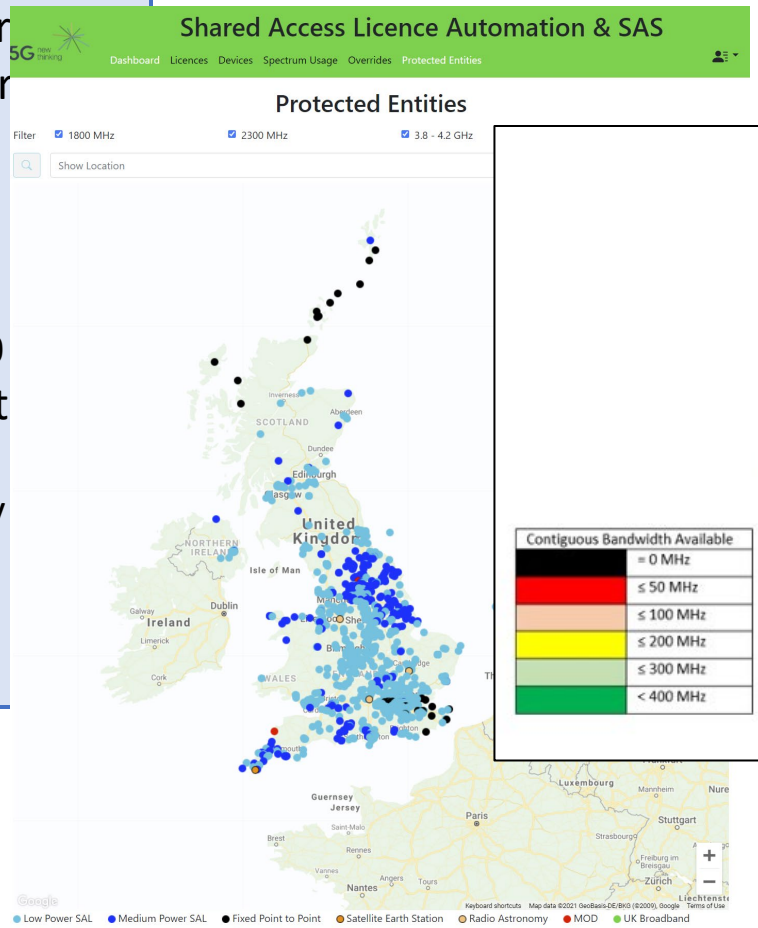
Prototyping, simulating, and assessing new method to streamline and increase spectrum access to SAL and LAL

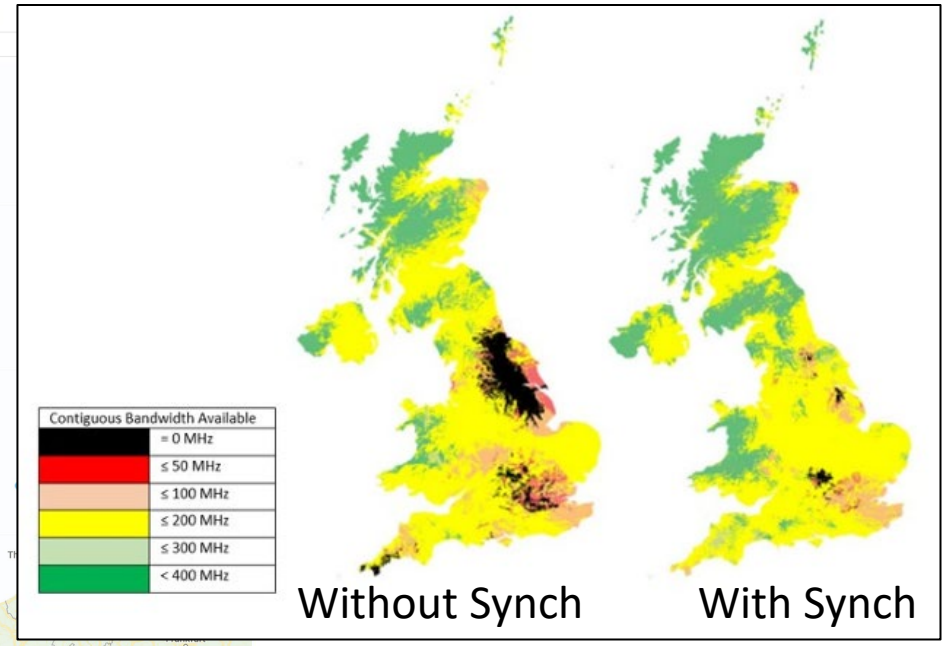
Shared Access Licences (SAL)

- Manual application for 1 yr renewable shared spectr licence for low power (urban) or medium power (rur private networks with device ecosystem support

1800 MHz (paired)	B3	1.4, 3 MHz
2390-2400 MHz	B40, n40	5, 10 MHz
3800-4200 MHz	n77	10-100 MHz
24.25-26.5 GHz	n258	50, 100, 200, 400

- OK uptake (~1k licences in WTR as of Nov 2024), but
  - Long waits (4+ weeks) for licence to be issued
  - No way of checking whether an application is likely succeed before applying
  - No MNO access (or at least no national networks)
  - Poor efficiency based on conservative protections





(Source: Ofcom)

December 2024 Ofcom Solution: User-led Coordination

	1800 MHz	2.3 GHz	3.8-4.2 GHz	26 GHz	Total
Low Power Licences	268	29	212	1	510
Medium Power Licences	126	NA	352	NA	478
Total November Licences	394	29	564	1	988
Delta to July Totals	+45	-	+68	-	+113

(Source: Ofcom)

Local Access Licences

- **What a LAL Is**: 3 year access (non-renewable) to unused MNO spectrum (19 to date)
- **Why**: Good device availability, wide coverage
- **Poor Uptake** – 27 Licences
- **Challenges**
  - No clearly defined standards for access
  - Successful access requires coordination with both Ofcom and MNOs
  - Protect current and *Future* MNO Operations
  - No incentive for the MNOs

Ofcom **Local Access Licences**

10 06 2024 Total issued: 27

Licensee	Licence Number	Licence Period		Spectrum	Band	Location	National licensee
MoD - CISTDU	1330954	18/09/23	17/09/26	1866.5-1876.5 MHz 1771.5-1781.5 MHz	3	Westdown Camp, Wiltshire	EE
MoD - CISTDU	1330951	18/09/23	17/09/26	1866.5-1876.5 MHz 1771.5-1781.5 MHz	3	Longmoor Camp, Hampshire	EE
MoD - CISTDU	1330948	18/09/23	17/09/26	1866.5-1876.5 MHz 1771.5-1781.5 MHz	3	Blandford Camp, Dorset	EE
MoD - CISTDU	1330944	18/09/23	17/09/26	1866.5-1876.5 MHz 1771.5-1781.5 MHz	3	Dorset Industrial Park	EE
Freshwave	1353643	22/05/21	31/05/26	2620-2640 MHz 2500-2520 MHz	7	Thurston, Dunbar	Vodafone
Freshwave	1353641	22/05/21	31/05/26	2620-2640 MHz 2500-2520 MHz	7	Erigmore, Dunbar	Vodafone
Freshwave	1327790	18/09/23	20/05/26	2620-2640 MHz 2500-2520 MHz	7	Warmwell, Dorset	Vodafone
Freshwave	1327772	18/09/23	20/05/26	2620-2640 MHz 2500-2520 MHz	7	Sandford, Dorset	Vodafone
Freshwave	1314257	14/04/23	13/04/26	2575-2595 MHz	38	Invergordon, Scotland	Vodafone
Freshwave	1306565	07/02/23	06/02/26	2575-2595 MHz	38	Pwllheli, North Wales	Vodafone
Skylight Broadband	1331263	11/09/23	08/12/25	3600-3660 MHz	43	Liskeard, Cornwall	Three
Telet Research (NI)	1284302	27/07/22	26/07/25	1805.1-1810.9 MHz 1710.1-1715.9 MHz	3	RGHQ Chilmark, Wiltshire	Telefónica
Telet Research (NI)	1284291	27/07/22	26/07/25	1805.1-1810.9 MHz 1710.1-1715.9 MHz	3	Spread Eagle Hotel, Wiltshire	Telefónica
Telet Research (NI)	1284289	27/07/22	26/07/25	1805.1-1810.9 MHz 1710.1-1715.9 MHz	3	Knowle Farm, Dorset	Telefónica
Telet Research (NI)	1284285	27/07/22	26/07/25	1805.1-1810.9 MHz 1710.1-1715.9 MHz	3	Stoke Farthing House, Wiltshire	Telefónica
Telet Research (NI)	1284284	27/07/22	26/07/25	1805.1-1810.9 MHz 1710.1-1715.9 MHz	3	Bulbarrow Farm, Dorset	Telefónica
Bogons	1275820	01/04/22	31/03/25	1805.1-1810.9 MHz 1710.1-1715.9 MHz	3	Balquhidder Perthshire	Telefónica
Dorset Council	1273263	01/03/22	28/02/25	3460-3500 MHz	42	Dorset Innovation Park Monterey Avenue	Three
Dorset Council	1273260	01/03/22	28/02/25	3460-3500 MHz	42	Dorset Innovation Park Chesil House	Three
Freshwave	1268620	01/03/22	28/02/25	2620-2640 MHz 2500-2520 MHz	7	Pease Bay, Cockburnspath	Vodafone
Freshwave	1268598	01/03/22	28/02/25	2575-2595 MHz	38	Fallbarrow Windermere	Vodafone
Freshwave	1268564	01/03/22	28/02/25	2620-2640 MHz 2500-2520 MHz	7	White Cross Bay Windermere	Vodafone
Digital Intelligence and Investigation	1341715	01/02/24	31/01/25	2595-2615 MHz	38	Tyneham, Dorset	Telefónica
Kinected Solutions	1263360	01/01/22	31/12/24	2500-2510 MHz 2620-2630 MHz	7	Tilshead, Wiltshirre	Vodafone
Briant Broadband	1262006	26/09/21	25/09/24	2575-2595 MHz	38	Angmering Park, Worthing	Vodafone
Telet Research (NI)	1332273	18/09/23	17/09/24	1805.1-1810.9 MHz	3	Ross on Wye, Herefordshire	Telefónica
Skylight Broadband	1256815	25/08/21	24/08/24	3500-3540 MHz	42	Ashburton, Devon	Vodafone / Telefónica

https://www.ofcom.org.uk/siteassets/resources/documents/manage-your-licence/local-access/local-access-licences-june-2024.pdf?v=368839

Application of CBRS to Addressing SAL & LAL Problems

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Core Problems / Challenges Addressed

- Access to Fallow MNO Spectrum
  - Accurate assessment of current usage
  - Detecting and protecting future usage
- Streamlining Access
  - Reduce time for spectrum assignments from month(s) to minutes (or less)
- SAL Congestion
  - Automating synchronization
  - Cooperative and non-cooperative synchronization
- Minimizing Regulatory and Ecosystem Impact

QMUL Sandbox Solution Concepts to Problems

Problem	Solution / Approach
Access to Fallow MNO Spectrum	• DSA Server assigns spectrum to Secondary RANs while enforcing aggregate interference protections to MNOs • RANs sense / detect changes in MNO operations / coverage and report to DSA Server which coordinates assignment changes as needed
Streamlining access	• DSA Server assignments responsive in seconds • DSA Client software acts as middleware for RAN control and measurements • License to operate (lightly licenced) still managed by Ofcom
TDD Synchronization	• DSA Server aligns RAN configurations and assignments (OnGo variant) • Enforce / adapt based on RAN measurements
Realistic Coverage	• Measurements from RANs and drive testing update coverage
Interference assumptions	• Simulate / measure interference levels under varying operational configurations against 3GPP UE Performance Conformance specifications
Large margins due to propagation uncertainty	• Compare field measurements (truth) against traditional (terrain, clutter) and raytracing models to estimate the potential benefit for operating with nationwide raytracing

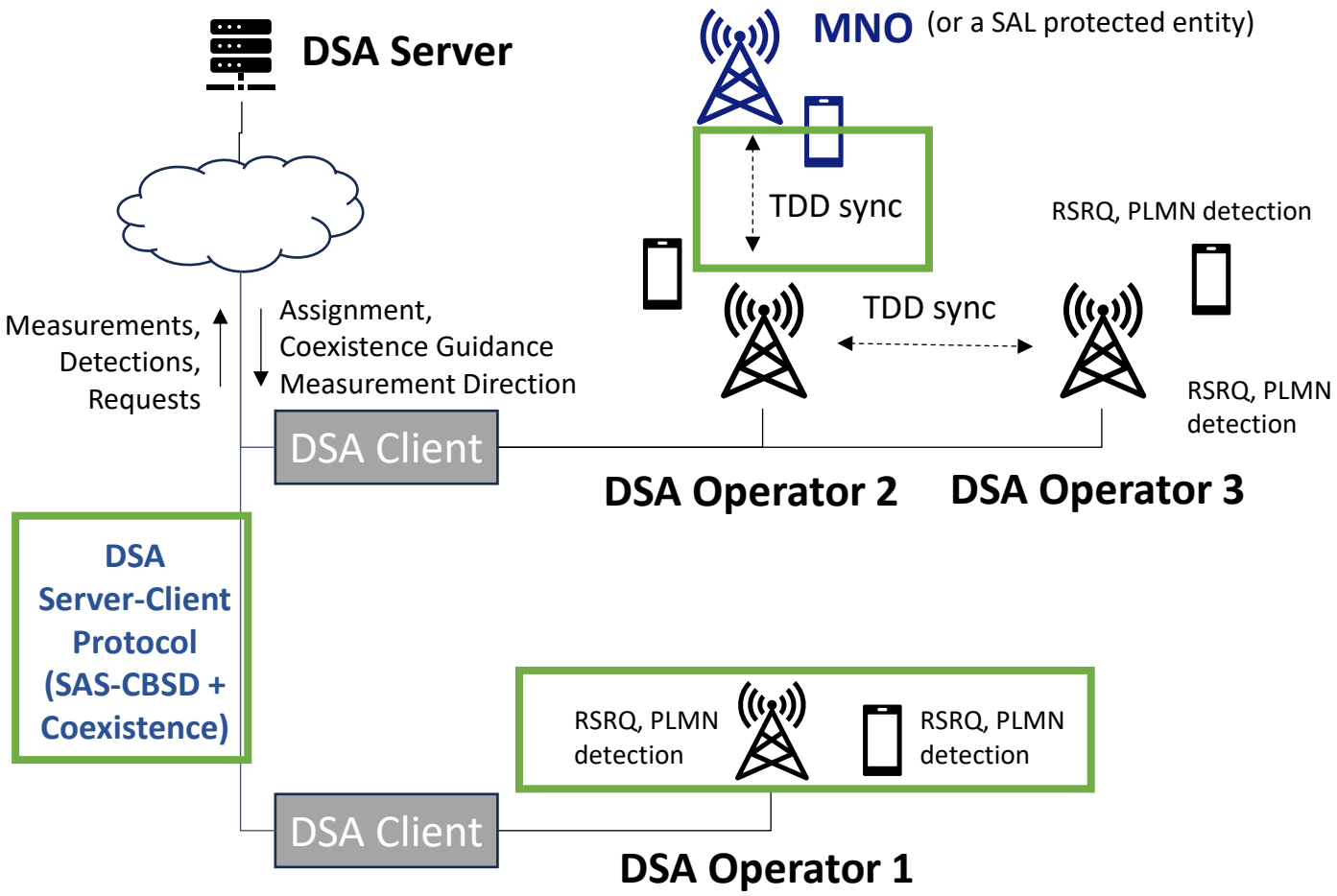
Common Approach to Access and Coexistence

Component	Description
MNO	Protected System. May be cooperative or non-cooperative
DSA Operators	Operators of RANs in spectrum unused by Protected System(s), holding a DLAL or DSAL licence
DSA Server	Responsible for protecting MNO operations from DSA Operators Provide configuration guidance to DSA Operators
DSA Client	"Middleware" that coordinates DSA RAN operations with DSA Server
RAN / UE	RAN / UE Operations + collect measurement reports
DSA Server-Client Protocol	Messaging by which DSA Server and Clients coordinate secondary access and operation

DSA Server-Client Protocol

- Builds on SAS-CBSD + Coexistence Protocol (TDD)
- Measurement reports include PLMN detections (incumbent MNOs, other nets)
- Leverages existing Ofcom licenses

System Architecture Diagram

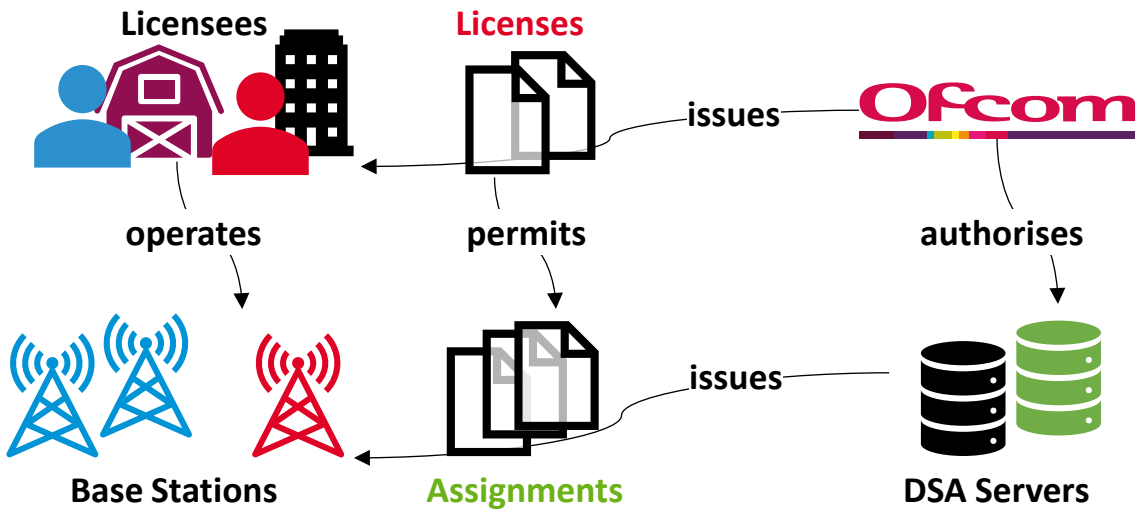


Same approach for DSA LAL and DSA SAL (and others?)

Minimizing Regulatory Impact

Preserve existing licences and protections
Split Licence Issue and Spectrum Assignment into separate processes

- Operator is issued a **long-term licence** via Ofcom's LPE, allowing ongoing Dynamic LAL or SAL operation as directed by a **DSA Server**.
  - LPE: https://www.ofcom.org.uk/spectrum/radio-equipment/licensing-updates
- The DSA Server uses Ofcom's methods to make **short-term spectrum assignments automatically** and immediately for each radio.
- For DLALs, radios automatically contact the DSA Server and transmit accordingly – protects evolving MNO usage without needing their input (still always a good thing)
- For DSALs, which are first-come-first-served:
  - Humans use the DSA Server's web page, and manually configure their radios accordingly;
  - and/or Radios automatically contact the DSA Server and transmit accordingly



Protocol / Ecosystem Changes from CBRS

- **Multi-jurisdiction** – rules and protections enforced by the DSA Server depends on the spectrum accessed by the DSA Operators, e.g., SAL vs LAL or potentially across countries
- **PLMNs and Measurement Reports**
  - Measurement reports include PLMN and TDD information from detected networks
    - 1) Sense and avoid LALs, 2) non-cooperative TDD alignment, 3) enforcement
  - Own PLMN reported with coexistence group (in addition to TDD configuration support)
  - Measurement reports before transmitting in LAL bands
- **Sensing Handling from RAN**
  - Coordinated Sense and Avoid
    - Operator's hardware listens for new MNO usage, or other SAL usage (including TDD details) and reports to DSA Server
    - DSA Server adjusts the assignments of all operating stations in the area
  - Map measurements / detections to Census Output Areas (OAs)

Measurements within OA	Result
No measurements	No change
Measurements showing no connectivity in Band 3	Remove OA from Coverage
Measurements showing connectivity in Band 3, all of which at < -105 dBm	Remove OA from Coverage
Measurement showing connectivity in Band 3, at least one >= -105 dBm	Add OA to Coverage (if not already present)

Summary

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Solution: Licensed Dynamic Spectrum Access (DSA) + Coordinated Sense and Avoid

Licence issue and spectrum assignment are split into separate processes:

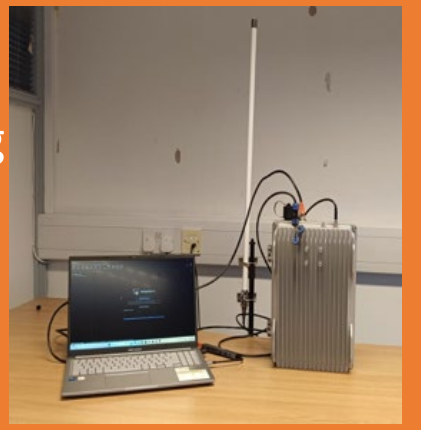
- User obtains long-term licence from Ofcom, allowing equipment operation with spectrum assignments from an automated DSA Server. Similar to CBRS and 6GHz AFC in USA
- The **DSA Server** implements Ofcom's assessment algorithms and **assigns spectrum automatically** and immediately
- For LAL frequencies, radios automatically contact the DSA Server and transmit accordingly – if spectrum not currently being used by the mobile operator, answer is "yes"
- For SAL frequencies, humans could use the DSA Server's web page for assignments, and then manually configure their radios – perfect for outside news broadcasts

Coordinated Sense and Avoid:

- Local operator radios monitor spectrum for new MNO usage and other interference and reports to DSA Server (**Sense**)
- DSA Server adjusts assignments for reporting and other operating stations in the area (**Coordinated Avoid**)

We built **a working Proof-of-Concept prototype** of Licensed DSA + Coordinated Sense and Avoid in B3.

Demo shows a 4G radio getting and using assignment from Server, reporting detection of new mobile operator signal, and moving to a vacant channel at DSA Server direction



Summary

- UK Department for Science, Innovation, and Technology funded three experiments to prototype new mechanisms to improve UK spectrum sharing and efficiency
- QMUL (and FW and Telet and Aetha) project adapted existing CBRS mechanisms to these bands to leverage the existing ecosystem
- With relatively light effort, we think CBRS mechanisms can adapted to the specific requirements of bands around the world even when there are differences with CBRS

- DSIT Sandbox Briefings on June 3 in UK Spectrum Policy Forum
  - 9 AM-12 PM UK Time
  - More focused on policy, economic, and simulation outcomes
  - Also an Ofcom briefing on SAL updates

Backup Slides

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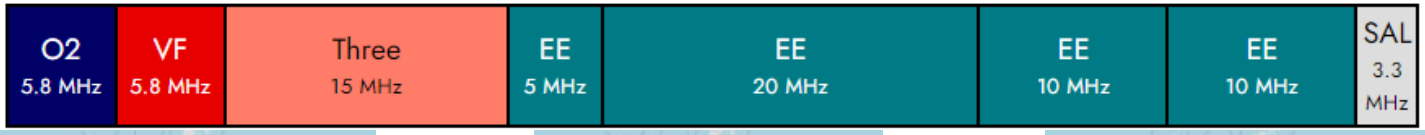
Problem 1: How to better utilize ‘fallow’ MNO spectrum?



Allocation from: https://mastdatabase.co.uk/

- 5-10 MHz+ in Band 3 is unused in much of UK (other bands are likewise) though Ofcom Mobile Coverage Checker is much too optimistic
- LALs made this available in principle, but are commercially unviable in practice
- ‘Not-spots’ present commercial opportunities to ‘New entrant’ operators’
- This project is investigating a practicable solution for **protecting current and evolving MNO usage** from secondary licensees.

Related Problems

Streamlining Access Procedures

- Existing SAL & LAL procedure is cumbersome and overly manual
  - Month for SAL, Year for LAL
  - LAL is unpredictable (commercially unviable)
  - High administrative burden for the licence applicants, for Ofcom, and for MNOs (LAL only)
    - Ofcom's LPE project will automate *submitting* an SAL application but **not** the burdensome *processing and approval.*
  - SALs & LALs not suited for short-term use
- This project is **prototyping** a practicable automated solution

Increasing Capacity by Better Modeling

- Several assumptions reduce capacity
  - Secondary systems modeled as uncooperative / not synchronized
    - See impact of TDD alignment in Expanding Access to Shared Spectrum, Statement & Consultation, Ofcom, July 2024
  - Overly optimistic / conservative estimates of coverage results in operational not-spots
  - Overly protective interference assumptions decrease secondary availability
  - Inaccurate / imprecise propagation predictions increase protection margins and decrease capacity
- This project is **studying** (measurements, simulation, analysis) better parameters and methods to regain capacity

WP2: Converting Measurements to Availability

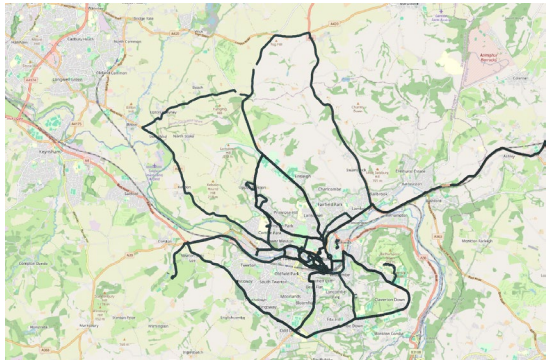
Issue: Official Coverage Data (Mobile Coverage Checker, Ofcom) is very optimistic

- Coverage by technology (3G, 4G, 5G) not by band / subband
- MNO coverage claimed with limited validation

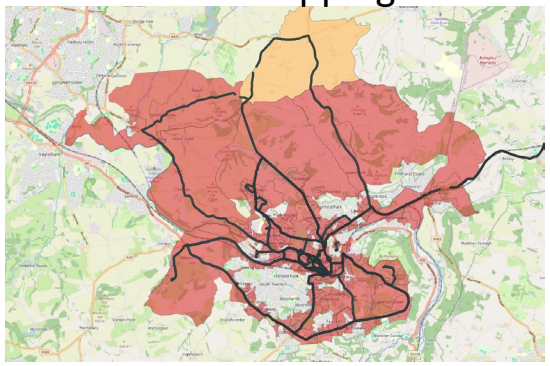
Need method to update coverage from measurements: Map by Census Output Areas + Fill in small surrounded OAs

Measurements within OA	Result
No measurements	No change
Measurements showing no connectivity in Band 3	Remove OA from Coverage
Measurements showing connectivity in Band 3, all of which at < -105 dBm	Remove OA from Coverage
Measurement showing connectivity in Band 3, at least one >= -105 dBm	Add OA to Coverage (if not already present)

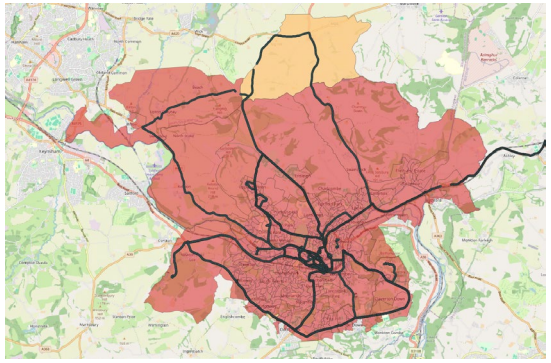
1. B3 VF Measurement Locations



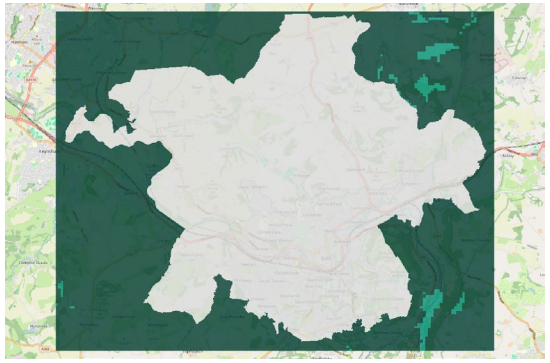
2. OA Mappings



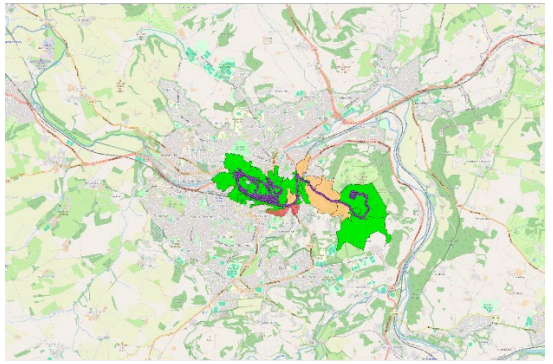
3. Fill In



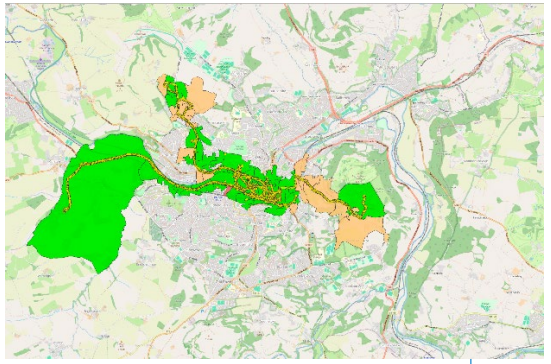
4. Updated Coverage



B3 EE OAs



B3 Three OAs



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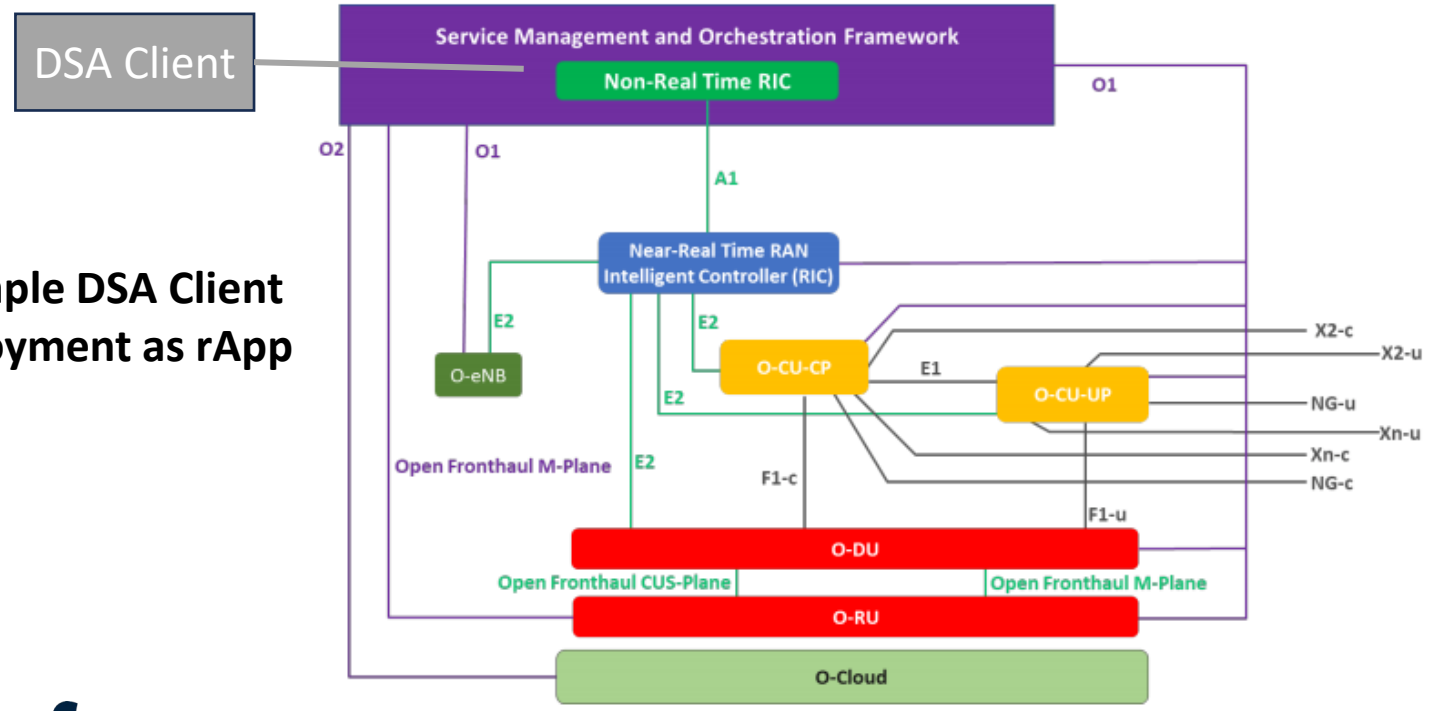
DSA Server Design Notes

Function	Approach	Comment
Determine MNO Usage	• Public / reported usage when available • Measurement Reports (PLMN decode)	• Official public usage and coverage data is poor
Determine DSA Availability	Predict aggregate interference to MNO remains below threshold • DSA Operator Site Configuration • MNO coverage and / sites • Standard path loss models	• Using 5GNT SAL backend, and some components of LAL backend • Thresholds are a study item. • Server is designed to support multiple regulatory rulesets and coexistence algorithms
Coordinate secondary usage	• Manage access through grant requests / assignments and heartbeats • Manage coexistence via coexistence groupings • Issue measurement report requests	• Heartbeat period and grant durations are configurable and variable • Secondary-to-secondary coexistence is primarily TDD synchronisation
Detect and correct errors	• Measurement reports • Interference reports	• Measurements from DSA Systems • Interference reports from MNO or DSA Operators

DSA Client Design Notes

Function	Approach	Comment
Detect MNO or coexistence issues	• Signal quality • PLMN detections	• RSRP, RSRQ, qualitative measures • PLMN easier from UE than gNB
Configure RAN, Collect configuration info	• Leverage existing management interfaces	• SNMP, EMS, SMO, NETCONF/YANG

Example DSA Client Deployment as rApp



ORAN arch from: https://www.aarna.ml/post/o-ran-architecture-the-smo

DSA Server-Client Protocol Summary

- Machine-to-machine protocol with which the DSA Server and DSA Client exchange messages; documentation is a project deliverable, currently at v1.3
- REST (JSON over HTTPS), Client sends request to Server, Server responds to Client.
- Spectrum Access mechanism borrows from CBRS, AFC, and 5GNT
- Coexistence/reporting mechanism borrows from OnGo Coexistence protocol (CBRS extension)
- Basic mechanism derives from from OnGo Coexistence protocol (CBRS extension).
- **This project is adding novel extensions** to support the assumed DLAL/DSAL licensing:
  - “Dialects” for band- and jurisdiction-specific extensions
  - Measurements and Coexistence Messages can extend / accompany any Protocol message
  - Allows gNB to report measurements before requesting to transmit
  - (also supports non-gNB sensors)
  - Measurement reporting / instruction of PLMN
  - TDD alignment & time sources
  - Mandated support for U/D split of 2/1

Problem: Enhancing Spectrum Access

1. **Local Access Licences** (LALs) enable small operators to use national mobile operator spectrum in areas where it is not used - but LALs are **commercially unviable**.
   - Ofcom allocates spectrum to LALs, requiring input from mobile operators, takes 4-6 months
   - Provides protections for possible *future* mobile operator use which may not occur
2. **Shared Access Licences** (SALs) enable wide range of organisations to use 5G spectrum for **range of use-cases** but are not suitable for short-term/short-notice uses
   - Ofcom will automate SAL applications (LPE), but still assess them **manually**, taking around 6 weeks; this is cumbersome even for long-term use-cases.
   - **No short-term and/or short-notice use**
     - BBC (etc.) would like to use for ~1000 outside broadcasts per year if they could, producing enhanced content at reduced cost;
     - Private networks for festivals;
     - Mobile operators could also use this spectrum for high-density infill for short-term events if authorised
3. UK could derive more economic & social benefit from its spectrum with more streamlined and efficient licensing & processes
   - Ofcom uses complex algorithms to assess whether a transmitter will cause interference to other licensees, but these can be automated and accuracy enhanced (e.g. using AI/ML)

Solution: Licensed Dynamic Spectrum Access (DSA) + Coordinated Sense and Avoid

Licence issue and spectrum assignment are split into separate processes:

- User obtains long-term licence from Ofcom, allowing equipment operation with spectrum assignments from an automated DSA Server. Similar to CBRS and 6GHz AFC in USA
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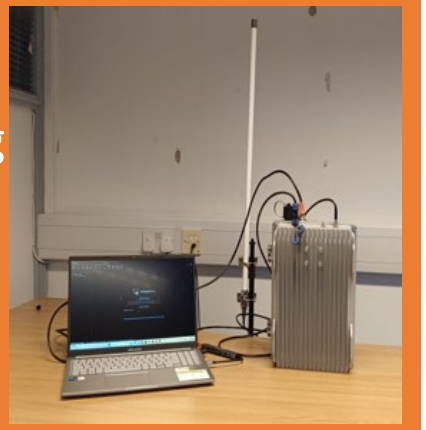

Ofcom Dec 2024 Enhancing the Shared Access Framework

Outcome	Summary of decisions taken in July
Improvements to spectrum supply	In the 3.8-4.2 GHz band, we confirmed steps to significantly reduce separation distances between Shared Access users, based on changing our assumption that base stations are unsynchronised to the assumption that they are synchronised and that the dominant interference path is therefore between users' base stations and terminals.
	In 3.8-4.2 GHz we also confirmed an updated approach to coordinating with UK Broadband, and new Building Entry Loss assumptions.
	Across all Shared Access bands, we freed up applicants to make their own local coordination agreements (and will in future also allow users to select antenna envelopes from an antenna library as part of our coordination process to support more sharing).
	We confirmed that we would add 2320-2340 MHz to our Shared Access framework for Low Power indoor use only, reflecting the sharing arrangements agreed with the MoD.
Liberalising rules to support more use cases	We confirmed that in the future we will increase by 3 dB the maximum power limit of our 'Low Power' product in 3.8-4.2 GHz, supporting wider coverage and improving access to available equipment.
	We removed a requirement to maintain records for mobile terminals connected to Low Power indoor base stations in the 3.8-4.2 GHz band (the TRR'), enabling more 'neutral host' style solutions.

Executive Summary

- We assume a Spectrum Sharing Framework (prototyped and tested in WP1):
  - **"Dynamic Licensed Spectrum Access"** in the SAL and LAL bands, alongside the existing SAL & LAL approaches (which we assume will continue unchanged)
  - We are not considering licence-exempt use
  - Operator acquires a "DLAL" or "DSAL" licence from Ofcom, specifying a band and a geographic region
  - The DLAL or DSAL licence confers the right to transmit within parameters specified by a "DSA Server", in response to requests for specific frequencies, locations, and technical parameters, within the ambit of that licence, for a specified time period.
- The DSA Server implements the existing SAL algorithms for DSALs
- The DSA Server implements custom DLAL algorithms (using parameters derived in WP2) for:
  - Granting spectrum access to protect **current** primary licensee usage
  - Incorporating gNBs' and UEs' spectrum measurements for "Centralized Detect & Avoid", to protect **evolving** primary licensee usage in real time
- This framework will enable (the value of which will be assessed in WP3):
  - Practicable and commercially-viable use of DLALs to fill not-spots without causing harmful interference
  - Practicable short-term and/or short-notice use of DSALs in bulk and/or for events
  - Practicable implementation of Ofcom's recent assumption of TDD "synchronized" SALs

Spectrum Sharing Mechanism Overview / Takeaways

- Two types of licence, One SAS
  - DLAL and DSAL are different licences with different coexistence processes, but the broad problem is the same: deconflict secondary licensees from primary licensees
  - One DSA Server can support both
  - Secondary-to-secondary coexistence problems are the same (aligning TDD configurations etc.)
  - DSA Server can support all LAL & SAL bands, not just the study bands of this project
- Why combine?
  - Precedent (e.g. CBRS ecosystem)
  - Very similar information and messaging for the two types of licence
  - Cost savings for Ofcom and the DSA Server operator(s)
  - Large impact on efficiency and capacity (project study item)
- Approach may be generalisable to other 3GPP bands and pairings in future

Parameter	R/O/C	Parameter Information
NAME: *signalEarfcn* DATA TYPE: number	Required	Indicates the EARFCN of the LTE signal or NR-ARFCN of the NR signal. For *signalRat* = LTE, permitted values are integers between 55240 and 56739 inclusive. For *signalRat* = NR, permitted values are even integers between 636668 and 646666.
NAME: *signalRat* DATA TYPE: string	Conditional	Indicates the RAT associated with the signal. When used in *cellInfo*t, the allowed values are "LTE" and "NR". Otherwise, allowed values are "LTE", "NR", and "UNKNOWN". This parameter shall be included if used in the *cellInfo* parameter.
NAME: *signalPci* DATA TYPE: number	Conditional	Indicates the PCI associated with the signal. For *signalRat* = LTE, permitted values are integers between 0 and 503 inclusive. For *signalRat* = NR, permitted values are integers between 0 and 1007 inclusive. This parameter shall be included if the *EutraInfo* object carries information of the transmitted signal. This parameter shall be included if used in the *cellInfo* parameter.
NAME: *signalEcgi* DATA TYPE: string	Conditional	For *signalRat* = LTE, indicates the ECGI associated with the signal. It is a string of length 52, containing 0's and 1's. For *signalRat* = NR, indicates the NCGI associated with the signal. It is a string length 60, containing 0's and 1's. This parameter shall be included if the *EutraInfo* object carries information of the transmitted signal. This parameter shall be included if used in the *cellInfo* parameter.
NAME: *signalBandwidth* DATA TYPE: number	Required	Indicates the bandwidth of the signal. Bandwidth of the signal is in 100's of kHz (E.g. number 200 indicates bandwidth of 20MHz).
NAME: *plmn* DATA TYPE: number	Conditional	Indicates the PLMN ID of the associated signal in a *MeasurementReport* message. Required when describing a DSA Client's own signal.

Parameter	R/O/C	Parameter Information
NAME: *Version* DATA TYPE: string	Required	This parameter indicates the version of the Coexistence Objects(s) sent to the DSA Client. The version of *Coexistence* Objects sent to the DSA Client shall be the same as the version of the *Coexistence* object from the DSA Client.
NAME: *eutraTddConfig* DATA TYPE: object: *EutraTddConfig*	Optional	If included, this parameter specifies the E-UTRA TDD Configuration or its NR Equivalent TDD Configuration that the DSA Client shall use for all its grants.
NAME: *nrTddConfig* DATA TYPE: object: *NrTddConfig*	Optional	If included, this parameter specifies the NR-TDD Configuration that the DSA Client shall use for all its grants. This parameter may be included by the DSA Server if the *eutraTddConfig* parameter is not present.
NAME: *coexMeasAssist* DATA TYPE: object: *CoexMeasAssist*	Optional	The DSA Server uses this parameter to send assistance information for coexistence measurements to the DSA Client
NAME: *clientFrequencyGuidance* DATA TYPE: array of object: *FrequencyRange*	Optional	DSA Server uses this parameter to provide guidance on the frequency range(s) the DSA Client is instructed to request and use going forward. Upon receiving this information, the DSA Client is expected to only request and hold spectrum grants that are within the received *clientFrequencyGuidance*. In the scenario where the guidance last received from the *SpectrumInquiryResponse -> availableChannel* object is in conflict with the last received *clientFrequencyGuidance*, the DSA Client should follow the latter for determining the frequencies on which to request spectrum grants
NAME: *PeerCoexAssistance* DATA TYPE: array of object: *CoexCellInfo*	Optional	Depending on DSA policy, the DSA Server may provide additional information to a DSA Client on the systems in its vicinity that may help the DSA Client implement its coexistence policies, e.g., nullsteering. Additionally, this should only be sent when the associated *CoexCellInfo* changes or is first available to the DSA Client.