

INTERNATIONAL PANEL

Moderator:
Prakash Moorut
(WInnForum Chief Regulatory Officer)

Panelists:

1. **Ms. Shalini Periyalwar (Canada)**
2. **Mr. Jose Arias (Mexico)**
3. **Mr. Emmanuel Faussurier (France)**
4. **Ms. Siew Yoon Tan (United Kingdom)**
5. **Mr. Christopher Hose (Australia)**
6. **Mr. Harin Grewal (Singapore)**



WinnForum Regulatory Advisory Committee

Main goals are to:

- facilitate the exchange of knowledge on technical topics, not to advocate for one policy position or another.
- help Forum members better understand emerging regulatory trends across all ITU regions.
- help the advisors understand emerging technologies that may impact or be impacted by the regulatory landscape.

Meetings:

- A conference call every 1-2 months or as needed.
- Face-to-Face meeting that suits the majority of proposed advisory committee members if possible.

Ms. Shalini Periyalwar (Canada)



Shalini Periyalwar is currently a Director, Communications Engineering at ISED, where her primary focus is on various aspects of spectrum management, including strategies for spectrum sharing.

Shalini has over 25 years of experience in the wireless communications industry, working on advanced research in radio systems engineering and in supporting IP strategy.

Over the course of her career, she has worked on leading edge research in all generations of wireless systems, with over a hundred US patents granted.

Shalini has also held academic positions and has published extensively in her academic roles.

Mr. Jose Arias (Mexico)



Jose Arias is General Director of spectrum planning at the Mexican telecom regulator (IFT), where he has been working since 2014.

He is responsible for setting the strategy for managing spectrum including refarming strategies, future band plans, introduction of new radiocommunication services, as well as international coordination and negotiations activities.

He has had several leadership roles including as Chairman of Committee 4 for Terrestrial services at WRC-19.

Jose has a Master degree in regulation and economic competition and an Electronic and Communications Engineer degree.

Mr. Emmanuel Faussurier (France)



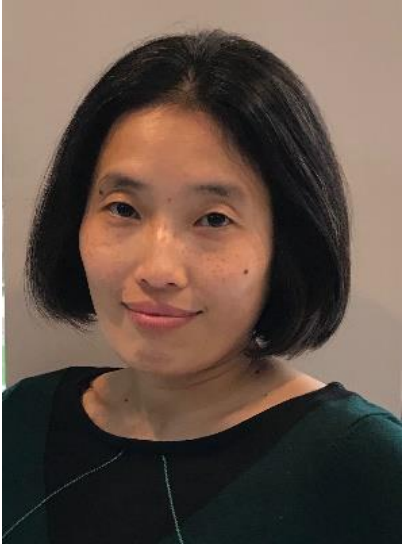
Emmanuel Faussurier is currently the deputy Head of spectrum innovation and European affairs and is responsible for the National Table of Frequency Allocations at France's Agence Nationale des Frequences.

He graduated in 1994 from the Ecole nationale supérieure des télécommunications de Bretagne – Brest (France). He also holds a master degree in Energy economics.

M. Faussurier has chaired several groups within CEPT, such as on UWB applications, automotive short-range radars, enhanced spectrum sharing solutions e.g. TV White Spaces and Licensed Shared Access (LSA).

He is also involved in international negotiation process at World Radio Conferences since WRC-12.

Ms. Siew Yoon Tan (United Kingdom)



Siew Yoon Tan is a Senior Technical Regulations Specialist at the UK communication's regulator, Ofcom. She led Ofcom's recent spectrum sharing initiative to enable local access in spectrum bands supporting mobile technology.

She has over 18 years' experience in radio spectrum management both in the UK and internationally, including chairing sub-working groups in CEPT and ITU-R.

Amongst others, she has previously led work to open up the 57-71GHz band for unlicensed use, set up the TV white space framework in the UK and led UK position on improving flexibility in the international regulatory framework in the ITU-R.

Siew Yoon is a Chartered Engineer and has a degree in Electronic and Communications Engineering.

Mr. Christopher Hose (Australia)



Chris Hose is the Executive Manager of the Spectrum Planning and Engineering Branch within the Australian Communications and Media Authority's (ACMA) Communications Infrastructure Division.

His responsibilities cover spectrum planning and engineering for radiocommunications and broadcasting services that contribute to national spectrum management, operational satellite network filing and coordination activities and international engagement on spectrum management matters.

Chris has a Bachelor of Electrical and Electronic Engineering from the University of Queensland, a Graduate Certificate in Public Administration from the University of Canberra, and a Masters of Engineering Science from the University of New South Wales.

Mr. Harin Grewal (Singapore)



Harin Grewal manages a cluster of divisions in Infocomm Media Development Authority (IMDA) that cover the technical aspects of telecommunications and broadcast regulation. This includes spectrum management, border coordination, interconnection, infrastructure coordination, numbering, regulatory price reviews and telecommunication standards.

As Executive Director of Singapore Network Information Centre (SGNIC), Harin also leads the Singapore NIC which is responsible for the management and promotion of .sg domain names, as well as internet domain and numbering related policies. SGNIC also carries out radio interference investigations and Quality of Service measurements on behalf of IMDA.

Harin is concurrently the Co-Chairman of Working Party 2, of Study Group 20 (Smart sustainable cities and the Internet of Things (IoT)) of the Standardization Sector of the International Telecommunication Union (ITU).

Presentations





Innovation, Science and
Economic Development Canada

Innovation, Sciences et
Développement économique Canada

Canada

UPDATE ON SPECTRUM RELEASES

Wireless Innovation Forum
Spectrum Sharing Deep Dive
International Panel

September 2020

**Spectrum
Outlook
2018-22**

priorities for low band, mid band and high band spectrum

**2020
consultations/
decisions
updates**

[3650- 4200 MHz](#): technical and licensing policy consultation August 2020

[3450-3650 MHz](#): auction rules released in March 2020, auction date June 15, 2021

TVWS

[White space database specifications](#) update Jan 2020

**6 GHz,
mm wave**

Conducting internal studies and monitoring global developments in 6 GHz band and mm wave (26 GHz, 28 GHz, 37-40 GHz) bands

REVIEWING OUR REGULATORY ENVIRONMENT TO IDENTIFY ANY IMPROVEMENTS/TWEAKS, IF NEEDED, FOR ENABLING DYNAMIC SPECTRUM SHARING

Recommendations related to spectrum sharing in the [broadcasting and telecom legislative review](#) to improve the related legislative tools

LEGAL FRAMEWORK

Examining opportunities for automated spectrum management for ensuring high data quality and leveraging complementary datasets to support DSA

DATA REQUIREMENTS

Spectrum sharing in Mexico

Jose Arias

◦ Spectrum sharing in Mexico

900 MHz

- Bands: 896-902 MHz and 928-952 MHz
- Sharing between: Narrowband Mobile, IMT, Railway systems, Fixed
- Geographic areas or operational conditions for specific services
- Only on some frequency ranges



2.3 GHz

- Band: 2.3-2.4 GHz
- Sharing between: IMT services for different uses cases
- Refarming of fixed services
- Social, Public and Private users



3.5 GHz

- Band: 3.4-3.6 GHz
- Sharing between: Fixed satellite services and FWA
- Exclusion radius of 2.5 km on specific earth stations
- Perimetral PFD at 2.5 km must not exceed $-148 \text{ dBm/m}^2 \text{ Hz}$



6 GHz

- Band: 5.925-7.125 GHz
- Sharing between: Fixed satellite services and Fixed services
- As the satellite link is Earth to space sharing it's more efficient
- Public consultation about the future use of the band



◦ Secondary use in Mexico

TV White Spaces

- Experimental deployments bands:
 - 174-216 MHz
 - 300-380 MHz
 - 470-608 MHz



Rules for secondary use

- Specific events (NFL, Formula 1)
- Commercial/Industrial facilities
- Short Range Devices



Other Documents

- National Spectrum Plan (PNER)
- Social use recommendations



Secondary market

- Spectrum leasing
- Spectrum swapping



Spectrum sharing challenges

WinnForum Online, 22-24 September 2020

Emmanuel FAUSSURIER, ANFR (France)
(emmanuel.faussurier@anfr.fr)

A) Frequency bands harmonised in Europe for mobile broadband

Existing harmonised frequency bands for MFCN (Mobile/Fixed Communications Networks)

Recent evolution to accommodate 5G / active antenna systems (AAS)

- 1800 MHz / 2 GHz / 2,6 GHz / 3,4-3,8 GHz

Information on [ECC decisions](#) (CEPT) and [EC Decisions](#) (EU):

Band	Frequency band	ECC Decision	EC decision	(Last modified by)
700 MHz	694-790 MHz	ECC/DEC/(15)01	2016/687 (EU)	
800 MHz	790-862 MHz	ECC/DEC/(09)03	2010/267/EU	
900 MHz	880-915 MHz / 925-960 MHz	ECC/DEC/(06)13	2009/766/EC	2011/251/EU
1800 MHz	1710-1785 MHz / 1805-1880 MHz	ECC/DEC/(06)13	2009/766/EC	2011/251/EU
L	1427-1518 MHz	ECC/DEC/(13)03 ECC/DEC/(17)06	2015/750 (EU)	(EU) 2018/661
2 GHz	1920-1980 MHz / 2110-2170 MHz	ECC/DEC/(06)01	2012/688/EU	(EU) 2020/667
2,3 GHz (LSA)	2300-2400 MHz	ECC/DEC/(14)02		
2,6 GHz	2500-2690 MHz	ECC/DEC/(05)05	2008/477/EC	(EU) 2020/636
3,4-3,8 GHz	3400-3800 MHz	ECC/DEC/(11)06	2008/411/EC	2014/276/EU (EU) 2019/235
26 GHz	24,25-27,5 GHz	ECC/DEC/(18)06	2019/784 (EU)	(EU) 2020/590

The 26 GHz band: The “pioneer” mm-wave band for 5G

European regulations for 5G at 26 GHz supports sharing with space services:

- For deployment of Earth stations in limited number, subject to market demand
 - EESS/SRS receiving earth stations in the 25.5-27 GHz frequency band: see [ECC/REC/\(19\)01](#)
 - FSS transmitting earth stations in 24.65-25.25 GHz frequency band: see [ECC/REC/\(20\)01](#)

The European framework amended post WRC-19 accounts for the provisions of Resolution 750 (Rev.WRC-19) for the protection of EESS in 23.6-24 GHz:

- Context where mass deployments of 5G can be anticipated earlier in Europe
 - More restrictive conditions for BS & UE apply from 1 January 2024
- Provision to prevent high-density deployment (Mobile, FWA) in the frequency band 22-23.6 GHz

Harmonised technical conditions at 26 GHz defined under the assumption of individual authorisation regime:

- [ECC Report 317](#) assess implementation under general authorisation regime: would require more complex sharing solutions to ensure sharing with space services and to protect scientific services

Implementation in France:

- **Arcep** has spectrum rights in the upper 1 GHz band (26.5-27.5 GHz) for mobile services (5G) in French NTFA since April 2019.
 - National authorisation procedure not established. **15 trials ongoing.**
 - Need for national agreement to facilitate sharing with EESS/SRS (e.g. Earth station in Toulouse)

The 2.6 GHz band: EU framework amended May 2020

New challenge to ensure coexistence in adjacent bands with active antenna systems (AAS)

- AAS systems cannot be fitted with additional external filters
- European regulations for the 2.6 GHz “FDD band” (2500-2570 MHz/2620-2690 MHz) includes an additional baseline power limit for FDD AAS base stations with regard to Radio Astronomy Service:
 - Maximum + 3 dBm/MHz TRP in 2690-2700 MHz
 - This limit yields a reduced coordination zone with respect to RAS stations

Implementation in France:

FDD band:

- Specific coordination procedure will need to be established for **FDD AAS base stations** in order to protect radioastronomy observation in Nançay

TDD band:

- The **2.6 GHz “TDD band”** (2570-2620 MHz) has been repurposed in 2018 by Arcep for 4G professional networks
 - <https://www.arcep.fr/demarches-et-services/professionnels/transformation-numerique-des-entreprises/guichet-frequences-2-6-tdd.html>
- Interest for the 2.6 GHz TDD band confirmed by stakeholders. Sharing possibilities in the **3.8-4.2 GHz band for local needs of “verticals”** are explored.

The 3,4-3,8 GHz band: The “primary band” for 5G in Europe

European framework amended in 2019 promotes large contiguous spectrum portions of preferably 80-100 MHz

- Includes an additional baseline power limit for non-AAS and AAS base stations to protect military radars below 3.4 GHz
- Designed for implementation under individual authorisation regime
- CBRS / 3-tier approach not suited in Europe

CEPT investigates the application of harmonised technical conditions for indoor small cells operating in the 3.4-3.8 GHz band

- Initial discussions on identifying indoor usage scenarios

Implementation in France:

- Commercial earth stations have been moved out from 3.4-3.8 GHz band
- 3410-3490 MHz: fixed wireless access (legacy and new), LTE based
- 3490-3800 MHz: Auction process ongoing until October. Authorisations granted before end 2020
- Coexistence issue at the border when different frame structures: [Draft ECC Recommendation \(20\)03](#)

5G Verticals are demanding solutions in France: the 3.41-3.49 GHz and 3.8-4.2 GHz bands may be natural solutions for local 5G vertical coverage. FSS earth stations cannot be moved from the 3.8-4.2 GHz band.

B) Investigations on other frequency bands for mobile broadband in Europe

Frequency band 6425-7125 MHz studied under agenda item 1.2 of WRC-23:

- **Key coexistence issue with uplink fixed satellite service:** the compatibility of IMT vs FS and FSS in the band 5925-6425 GHz was studied under agenda item 1.1 of WRC-15, leading to an indoor limitation to protect the incumbents.
- Would assumptions for 5G in 6425-7125 MHz lead to the same result?
 - Outstanding issue for CEPT planned questionnaire on the band 6425-7125 MHz: ***What could be the type of sharing solutions enabling to protect satellite reception in the band 6425-7025 MHz from IMT stations?***

Frequency band 40.5-43.5 GHz studied as “priority band” for second stage mm-wave 5G bands

- Authorisation regime to be clarified. No strong demand at this stage in Europe.
- Sharing with space services: **similar approach as for the 26 GHz band** with the planned development of “tool box” to support the introduction of 5G while ensuring, in a *proportionate way*, the use of FSS receiving earth stations in the band 40.5-42.5 GHz and the use of FSS transmitting earth stations in the frequency band 42.5-43.5 GHz

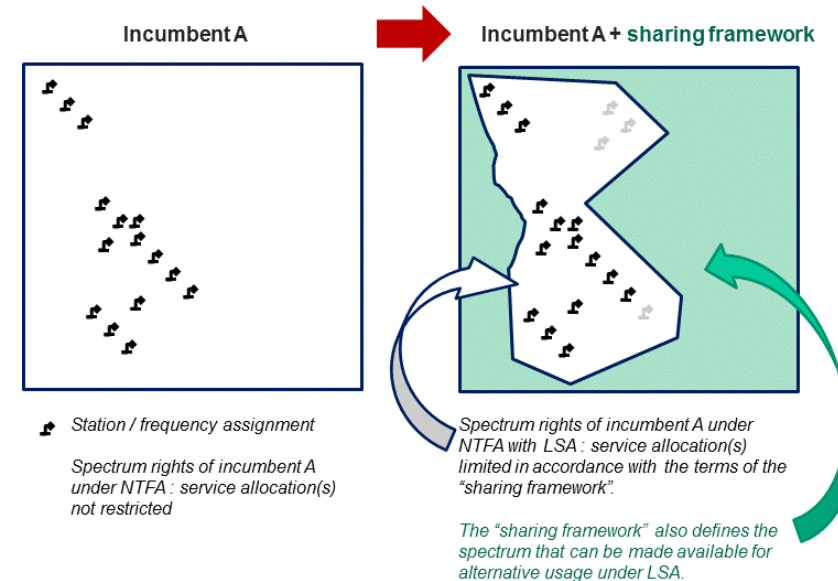
Frequency band 66-71 GHz also tagged as “priority band”

- Authorised in Europe since 2019 as part of SRD regulations for the use of the band **57-71 GHz**: would accommodate both 5G and WiGig technologies and applications
- General authorisation regime

C) Spectrum sharing solutions in licensed bands LSA

Licensed Shared Access (LSA)

- Concept (see [ECC Report 205](#)) initially introduced as an enabler to unlock access to additional frequency bands for mobile broadband under individual licensed regime while maintaining incumbent uses.
 - LSA licensees and incumbents operate different applications and are subject to different regulatory constraints.
 - LSA does not prejudge the modalities of the authorisation process to be set by Administration / NRAs taking into account national circumstances and market demand.



LSA, as a regulatory approach, recognizes the relevance in spectrum policy to identify new frequency bands for mobile broadband without the obligation to remove the existing users

- No need however for enhanced tool to support coexistence with limited number of fixed earth stations (e.g. 26 GHz)

Situation in France:

- The 2.3-2.4 GHz band: initially identified as a good candidate for sharing between mobile (new entrant) and military aeronautical telemetry. Incumbent uses has however evolved.
- No ongoing new investigations on LSA in France.

D) Spectrum sharing with license-exempt applications: 5 GHz RLANs & TV WS

5 GHz RLANs (5150-5350 MHz & 5470-5725 MHz) & Dynamic Frequency Selection (DFS)

Numerous interference cases on meteorological radars since 2005

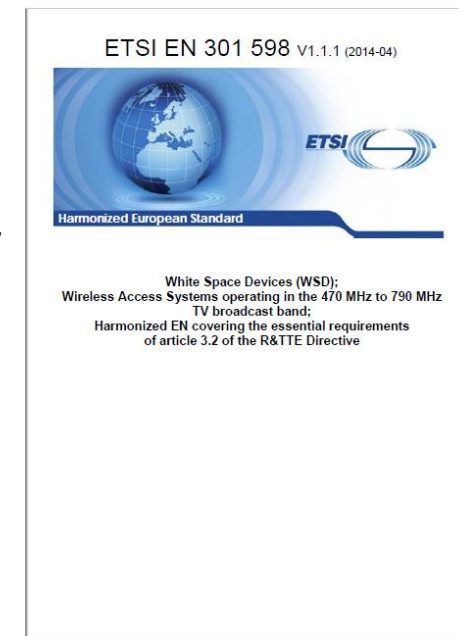
- DFS deactivation or modification by user identified as one of the main sources of interferences
- French administration has been very active for maintaining the “**user access restrictions**” clause in harmonised standard ETSI EN 301 893, even in the absence of corresponding test method

Need for greater trust in spectrum sharing solutions

- It is essential to ensure that end- user cannot change the parameters of sharing conditions (DFS or any other parameters)

TV White Space Devices & geolocation database solutions

- One key feature of European regulatory developments on TVWS is that a **WSD may only transmit in the territory of a country if it has successfully discovered a geo-location database approved by the National Regulatory Authority (NRA)**.
 - Device requirements set in [ETSI EN 301 598 V1.1.1 \(2014-04\)](#)
 - No ECC harmonisation measure
- The case of the TV WS proved unsuccessful in Europe due to the uncertainties on TV WS availability and complexity of the sharing
 - Some of the key principles introduced in the ETSI standard **could be re-used and adapted to other spectrum sharing situations**



D) Spectrum sharing with license-exempt applications: **6 GHz RLANs**

6 GHz RLANs (5945-6425 MHz)

European regulations for 6 GHz RLANs under final adoption phase, limited initially to LPI (Low Power Indoor) and VLP (Very Low Power) devices

- LPI : 5945-6425 MHz with max 23 dBm and **CDC**
- VLP Category A : 6025-6425 MHz with max 14 dBm
- VLP Category B : 5945-6425 MHz with max 14 dBm and **CDC**

Concept of Country Determination Capability (CDC) introduced in draft regulations adopted by ECC for public consultation (July 2020):

- The **CDC** functionality shall enable a device to determine whether the use is allowed or not allowed in a Member State and to operate accordingly

France is supporting a geolocation database sharing model as a win-win solution:

- Concerns about the protection of the fixed service (FS)
- Indoor restriction for LPI difficult to enforce
- **Outdoor applications are clearly incompatible with FS but may address some useful niche market** (e.g. wireless camera, internet access in remote areas...)
- Need for ETSI harmonised standard to include features such as geolocation capability, database discovery capability, common interface for data exchange between devices and databases etc.

European initiatives to support spectrum sharing

No “on size fits all” solutions...

but different European coordinated initiatives could facilitate spectrum sharing:

Foster geolocation database solutions in Europe

- Need for **regulatory bricks** to support implementing specific sharing/co-existence solutions, e.g. generic requirements for controlling emission/geolocation, high-level description of communication interface with the database, ...
 - **6 GHz WAS/RLAN could provide a good “proof of concept” for Europe, making other spectrum users confident**

Support sufficient guarantee on “User access restrictions”

- Need for sufficient guarantee that equipment cannot be modified by the user in a way which would affect the sharing/co-existence solutions
 - Meeting the sharing conditions in certain frequency bands cannot rely on information provided by the “packaging” of the device on user restrictions
 - Regulations may differ in some cases between Member States (e.g. SRD at 915 MHz)

Foster increased robustness and resilience to interference of radio equipment

- Development of high performance receiver specifications and inclusion of appropriate essential requirements and test specifications into harmonised and product standards, for all equipment (see [ECC Report 310](#))

Agence nationale des fréquences

78, Avenue du Général de Gaulle
94704 MAISONS-ALFORT CEDEX

+33 (0)1 45 18 72 72
www.anfr.fr

Rejoignez-nous sur :



[twitter/anfr](https://twitter.com/anfr)



[dailymotion/anfr](https://dailymotion.com/anfr)



[flickr/anfr](https://www.flickr.com/photos/anfr/)

Spectrum sharing to support wireless innovation

Siew Yoon Tan
September 2020

Making sure people and businesses have connectivity where and when they need it



Different spectrum sharing approach in different bands

National mobile spectrum



Local access licence:

Localised access in locations not impacting MNOs current and future deployment (July 2019)

Spectrum auction: 700 & 3.6 – 3.8 GHz (Jan 2021)

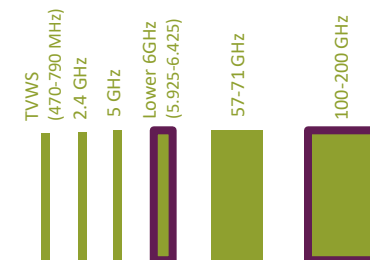
Shared spectrum



Shared access licence :

Localised access shared with incumbent/new users on first come first served basis (July 2019)

Unlicensed & light licence



6 GHz : Additional 500 MHz unlicensed for indoor WiFi and very low power outdoor use (July 2020)

100 -200 GHz : Low power unlicensed use and increase power under light licence (decision Autumn 2020)

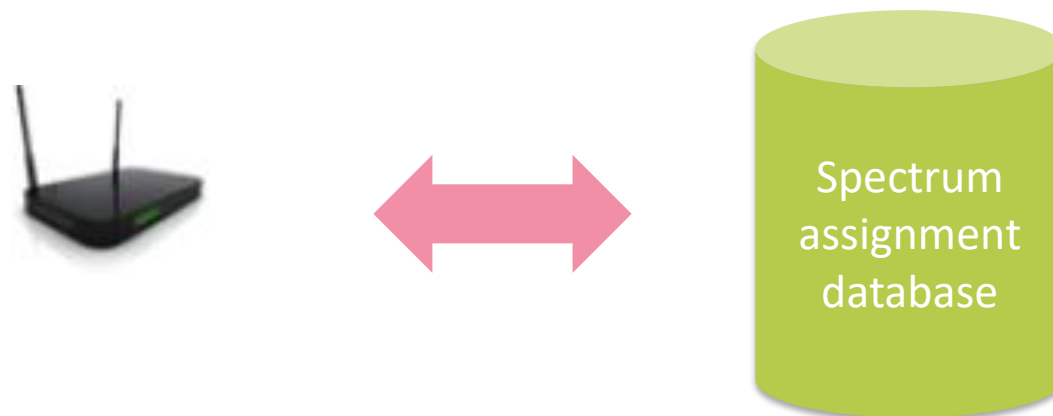
Our spectrum sharing framework

[Localised access](#) in spectrum supporting mobile technology for private networks and coverage extension.

	National mobile spectrum (local access licence)	Shared spectrum (shared access licence)
Bands available	Spectrum licensed on a national basis to mobile network operators	1800 MHz (2x 3.3 MHz) 2.39-2.4 GHz (10 MHz) 3.8 – 4.2 GHz (10 – 100 MHz) 24.25-26.5 GHz (50, 100, 200 MHz)
Technical conditions	Specify by users	Low power (24 dBm) Medium power (42 dBm)
Access type	Ofcom facilitates discussion with operators to assess impact on current and future deployment	Ofcom coordinates access for interference to/from other users on first come first served basis, deployment within 6 months
Licence duration	Maximum 3 years	Indefinite, annual renewal
Licence costs	£950	£80 - £800 (all bands except 26 GHz) £320 (26 GHz)

Evolution towards automated spectrum access

Ensuring efficient and effective sharing in the shared spectrum





Australian
Communications
and Media Authority

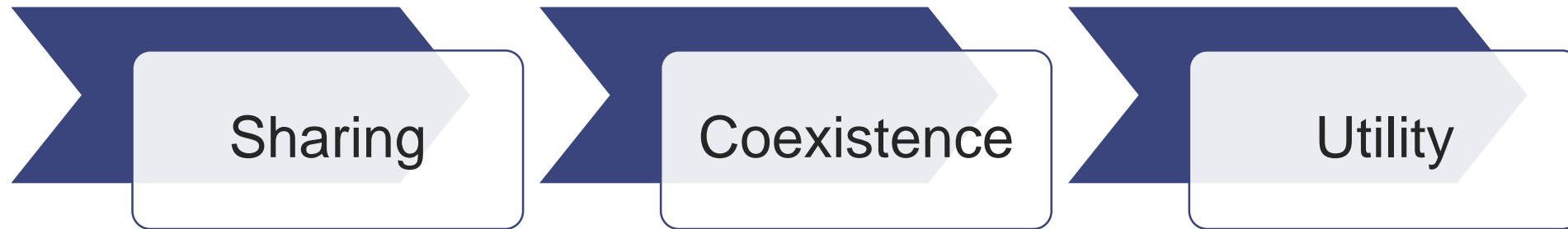
Spectrum Sharing

Australian Perspectives

Chris Hose
ACMA

Why spectrum sharing?

- > Useful to reflect on the 'why' of spectrum sharing before the 'how'
- > Sharing techniques are a means to an end

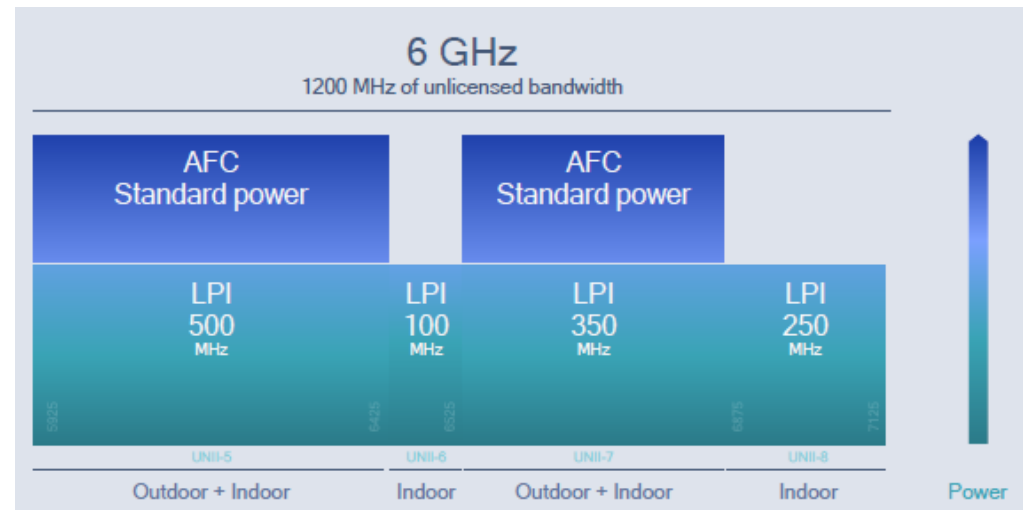


Choosing the best approach to spectrum sharing

- > Spectrum 'sharing' is not new – it has always been fundamental to spectrum management
- > Many ways to share the spectrum
 - > Traditional
 - > Non-traditional
- > The most appropriate sharing approach will depend on the circumstances
 - > Fit for the intended purpose informed by planning/policy decisions
 - > Balancing complexity/financial costs with benefits

Spectrum sharing in Australia

- > ACMA has maintained a close watch on 'non traditional' sharing approaches
- > To date, has not identified the case for implementing arrangements using new sharing approaches
- > However, the ACMA has commenced an investigation into the 6 GHz band (5925-7125 MHz) and it open to the possibility for new sharing approaches, including:
 - > Automated Frequency Coordination (AFC)/databases approaches



Source: Qualcomm, 2020



SPECTRUM SHARING IN SINGAPORE

24th September 2020

Harin S Grewal
Cluster Director
Networks, Technology and Resource

SG:D
EMPOWERING POSSIBILITIES

IM INFOCOMM
MEDIA
DEVELOPMENT
AUTHORITY

IMPORTANT notice

This presentation is protected by applicable copyright and/or other intellectual property laws. All titles, right and/or interest in this presentation is owned by IMDA.

This presentation also contains confidential information.

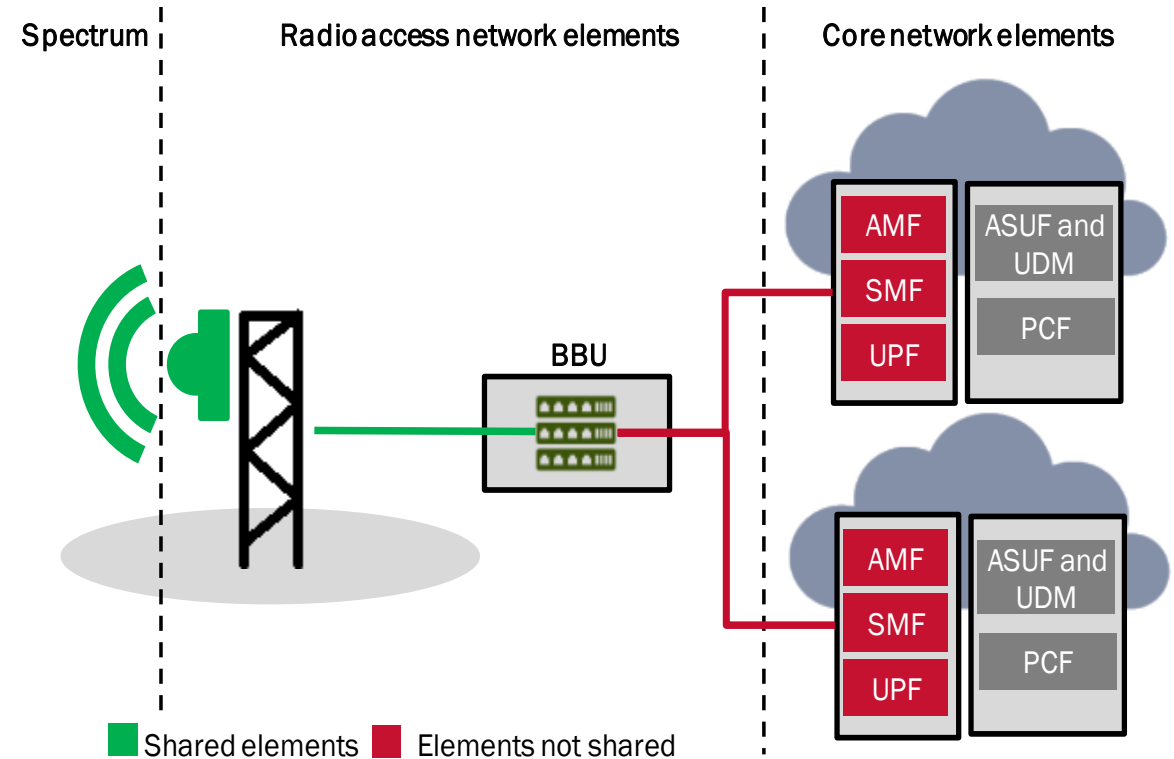
This presentation must not be used, reproduced or distributed in any form or by any means whatsoever without first obtaining IMDA's written permission. Unauthorised use, reproduction or distribution of any part of this document is prohibited.

The information contained herein represents the considerations of IMDA (as at the date of the document) and which is subject to change without notice. Nothing in this presentation shall preclude, limit or constrain IMDA's exercise of its rights, powers and discretion in any way nor compel, require or oblige IMDA to exercise its rights, powers and discretion in any particular manner or to achieve any particular outcome.

Network Sharing for 5G Mobile Services

- ❑ Joint-Venture Consortium (JVCo) formed by StarHub Mobile Pte Ltd and M1 Limited, was issued with the Final Award for 5G Call for Proposal on 24 June 2020
- ❑ M1 and StarHub has jointly selected the vendor to build the Radio Access Network (RAN) for the 5G standalone (SA) network infrastructure for the 3.5 GHz spectrum
- ❑ M1 and StarHub will deploy own 5G cores from their respective vendor(s)
- ❑ M1 and StarHub will continue to operate separately and provide retail services to their customers

Conceptual illustration of network sharing model that can be adopted

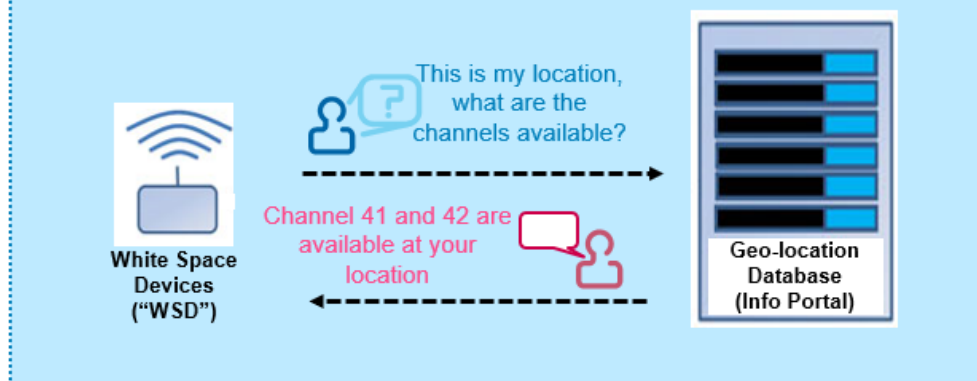


[Source: Analysys Mason, 2019]

TV White Space

- ❑ 24 channels in the TV broadcast bands are available (between 174 MHz and 230 MHz band, and between 470 MHz and 806 MHz) for TVWS operations in Singapore (~180MHz of spectrum)
- ❑ Plans to revise the TVWS band plan following Analogue Switch-Off and allocation of 700 MHz for mobile services
- ❑ The geo-location database approach is adopted for White Space Devices to access the TVWS spectrum

How TVWS Technology Operates:

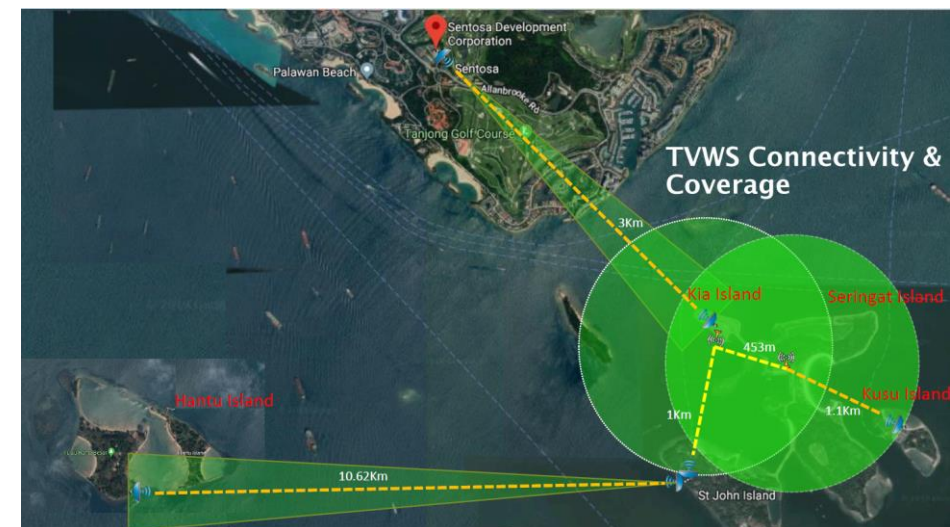


Possible use cases



Remote Island Communication Network Trial

Enable connectivity in remote locations/islands where there is poor connectivity to enable agencies to adopt and deploy IoT and robotics applications



A photograph of a white car body on an assembly line. A worker in a white shirt is using a power drill on the rear of the car. The car is positioned on a yellow and black striped safety mat. In the background, there are blue metal racks and various tools. The text "3.4-3.8GHz in Germany and Finland" is overlaid in white on the upper part of the image.

3.4-3.8GHz in Germany and Finland

Ulrich Rehfuess, Head of Spectrum Policy, Nokia

ulrich.rehfuess@nokia.com

German spectrum assignments in EU 5G pioneer band 3.4-3.8 GHz

- 3.4-3.7 GHz auctioned *) for nation-wide licences in Jun 2019 leaving some MNOs with less than the industry-recommended 80-100 MHz contiguous bandwidth
- 3.7-3.8 GHz is granted in an application procedure **) since Nov 2019 for local licenses providing spectrum for non-public networks



Selected conditions *) for local licenses in Germany in 3.7-3.8 GHz

- “Local” refers to property or group of jointly used properties, e.g. industry premises, campuses, agricultural or forestry
- Not for offer of a public service, i.e. limited to closed user groups
- Applicants have to provide a plausible business model description (confidentially) and prove technical expertise in order to ensure efficient frequency use
- Local licence owners either need to sync their TDD to the MNO at 3.7 GHz or provide the required guard band (or rather not licence the lowermost blocks required for guard)
- Neighbours are mandated to coordinate along their common borders, should that fail, BNetzA requires max 32 dB μ V/m/5MHz in 3 m height
- License duration is up to ten years, with extension option to max 31.12.2040 (end date of the MNO nationwide licences)
- Use-it-or-loose-it within 1 year
- Spectrum cost:

Spectrum fees in the 3700-3800 MHz band:

$$\text{Fee (in €)} = 1000 + B * t * 5 * (6a_1 + a_2)$$

where:

- 1.000 € - basic fee
- B - bandwidth in MHz (10 MHz up to 100 MHz)
- t - duration of frequency assignment (e.g. 10 years)
- a - area of the frequency assignment in square km
 - a₁ - settlement and traffic areas
 - a₂ - other areas (agrarian areas, forests, ...)

Example for industry – 100 MHz, 10 years, 1 km² =>
Fee is 31.000€

Finland offers spectrum leasing within nationwide MNO licenses in 3.4-3.8 GHz

- 3.410-3.800 GHz auctioned as nation-wide licences to 3 MNOs, 130 MHz each
- Provisions for sub-lease of MNO spectrum to local enterprises



A local enterprise can enter into a sub-leasing agreement with any MNO

Panel discussions

