Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: Summary of Ofcom consultation, TVWS: approach to coexistence

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Source: Sangsung Choi (ETRI) and Soo-Young Chang (SYCA)

Contact: sychang@ecs.csus.edu

Voice: +1-530-574-2741 E-Mail: sychang@ecs.csus.edu

Re: [802.15 TG4m]

Abstract: This document provides summary of Ofcom consultation paper regarding white spaces in Sep. 2013.

Purpose: To provide brief ideas regarding Ofcom's proposed approach and their consultation questions for white spaces.

Summary of Ofcom consultation TVWS: approach to coexistence

CONSULTATION DOCUMENTS RELEASED

- Consultation
  - Ofcom, TV white spaces: approach to coexistence
  - Publication date: Sept. 4, 2013
  - Closing date for responses: Nov. 15, 2013

- Two documents
  - Consultation paper:
    http://stakeholders.ofcom.org.uk/binaries/consultations/white-space-coexistence/summary/white-spaces.pdf
  - Technical analysis for this consultation:
    http://stakeholders.ofcom.org.uk/binaries/consultations/white-space-coexistence/annexes/technical-report.pdf

EXECUTIVE SUMMARY FROM OFCOM (1)

Introduction

- Demand for wireless data has grown rapidly, and continues to do so.
- Wireless data communications require access to radio waves, known as spectrum which is allocated using licences, or is made licence exempt.
- However in some areas, allocated spectrum is not used in all locations and/or at all times. This is referred to as "**white spaces**" and it can be used by other devices and services.
- A new way to access spectrum, known as **dynamic spectrum access (DSA)**, which is a form of spectrum sharing opportunistically.
- This consultation focuses on white spaces in the frequencies from **470 MHz to 790 MHz (the UHF TV band)** which are currently used for **Digital Terrestrial Television (DTT) and by Programme Making and Special Events (PSME) users**.
- Ofcom sees significant scope to enable it more widely and is currently consulting on the future role of spectrum sharing for mobile and wireless data services .

EXECUTIVE SUMMARY FROM OFCOM (2)

Ofcom's proposals

- It has previously been decided that **white space devices should be permitted to access the UHF TV band** subject to **ensuring that there is a low probability of harmful interference to other services in and adjacent to the UHF TV band .**
- This objective will be achieved **by restricting the power and frequencies** at which white space devices can transmit **at a given time and location** based on calculations of the amount of available white space in each location.
- There is uncertainty about the risk of harmful interference from white space devices.
- Overall approach to ensuring a low probability of harmful interference to other services is **to set parameters that may be able to relax in the future in the light of more experience**.
- Later this year, Ofcom **will test their proposals to the extent practicable in a pilot programme** comprising a number of trials around the UK by a range of service providers.

EXECUTIVE SUMMARY FROM OFCOM (3)

Ofcom's proposals (cont'd)

- Increased power levels will be allowed to be used for limited time periods to assist with this testing.
- The coexistence proposals will be refined in light of evidence both from the pilot and from stakeholders with a view to **finalising them in the summer of next year** ahead of the launch of **a full, nationwide solution in the third quarter of 2014**.
- A set of parameters and algorithms are proposed with the objective of ensuring a low probability of harmful interference from white space devices to:
  - **Digital Terrestrial Television services;**
  - **licensed users of equipment for Programme Making and Special Events (PSME); and**
  - **services above and below the UHF TV band.**
  - **services used by our international neighbours.**

EXECUTIVE SUMMARY FROM OFCOM (4)

White Space availability

- **The analysis from detailed initial modelling** of the potential effects of Ofcom's coexistence proposals suggests that:
  - The **constraints required for DTT** mean that the best performing white space devices can radiate at the maximum permitted power level in three or more 8 MHz channels at around 90% of households in the UK.
    - This figure falls to around 70% for less well-performing devices.
  - The **configuration of the DTT network** means that there is considerable geographic variability in white space availability.
    - For example, DTT constraints are substantially less severe in London than they are in Glasgow.
    - In Central London, the best performing devices would be able to access nine or more channels at maximum power at 100% of households, while in Glasgow (where the DTT environment is more challenging), these types of device would only have access to three or more channels at around 60% of households.

EXECUTIVE SUMMARY FROM OFCOM (5)

White Space availability (cont'd)

- **PMSE use is only likely to impose material additional constraints** on white space availability **in some locations.**
  - For example, PMSE constraints (when combined with DTT constraints) reduce the availability of white space in Central London so that better-performing devices would only be able to operate at maximum power in nine or more channels at around 90% of households.
  - In Glasgow, by contrast, PMSE would impose almost no additional constraint on availability.

SOME ACRONYMS

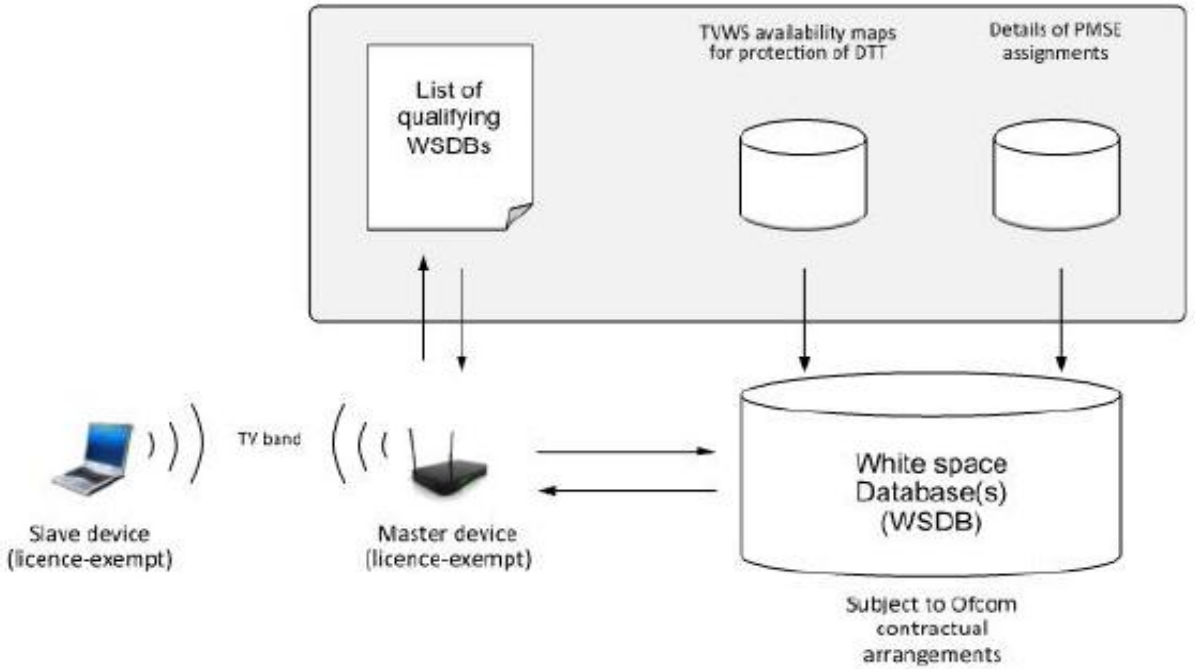
- DSA: Dynamic Spectrum Access
- DTT: digital terrestrial TV
- PMSE: Programme Making and Special Events
- WSD: White Space Device
- WSDB: white space database

INTRODUCTION (1)

- Dynamic Spectrum Access (DSA)
  - a means for enabling access to spectrum that is unused in particular locations at particular times.
- White Space Devices (WSDs)
  - do DSA by using up-to-date information about existing spectrum use in order to identify and access frequencies which would otherwise sit unused, while at the same time seeking to avoid harmful interference into existing users.
- A wide range of different potential services of WSDs
  - hot-spot coverage, in a similar way to Wi-Fi hotspots;
  - in-home broadband, again similar to Wi-Fi;
  - in-home multimedia distribution, for example to send video from one room to another;
  - rural broadband; and
  - machine-to-machine communications.
- Approach for this consultation to implement DSA
  - uses white space databases (WSDBs)
  - for the UHF TV band: currently used by Digital Terrestrial Television (DTT) and Programme Making and Special Events (PMSE) users.
  - WSDBs will be qualified by Ofcom in a process which will also be tested in the pilot.

INTRODUCTION (2)

- Under this approach
  - WSDs provide their location information to WSDBs.
  - WSDBs, in turn, inform the devices **which frequencies** they can use, and **at what powers** which vary over time.
- TVWS framework
  - Ofcom's role
  - WSDB's role
  - "master" or "slave" role of WSDs



INTRODUCTION (3)

Ofcom's role of TVWS framework

- Ofcom will **run a model using algorithms and parameters** designed to calculate white space availability to ensure a low probability of harmful interference **to DTT services**:
  - **different from FCC's where WSDBs performed these calculations**.
- Ofcom combines output from the model with additional restrictions
  - to ensure a low probability of harmful interference to services above and below the UHF TV band
  - to avoid causing harmful interference to neighboring countries.
- Ofcom provides this output to WSDBs.
  - This output will be updated when any changes in DTT networks: expect approximately every six months.
  - If necessary to resolve a case of interference, Ofcom will also be able to send updates outside the three hour cycle.

WSDB's role of TVWS framework

- The WSDB will **run its own model using the PMSE data set** and will use a specific a set of algorithms and parameters designed to ensure a low probability of harmful interference **to PMSE services.**
  - It will combine the outputs of this model with the outputs from the Ofcom DTT calculations to determine the available channels and powers for the relevant location.

INTRODUCTION (4)

Master WSD's role of TVWS framework

- The WSDB will communicate the available channels and powers to the master WSD.
- The master WSD will then broadcast a generic set of operational parameters for use by any slave devices associated with it.
  - **If the slaves cannot geolocate, they will need to use these (more restrictive) generic parameters.**
  - **If a slave can geolocate, it can request potentially less restrictive parameters from the WSDB via the master device.**
- The master WSD must check **with a specified frequency** (which for the purposes of the pilot will be **every 15 minutes**) or whenever it moves location, that the channels and powers given by the WSDB are still valid.
  - A master WSD should stop using any channels it is told are no longer valid, or reduce power if required.
- **The master WSD must also instruct its slave WSDs** to stop using the same channels (or reduce powers).
- Moreover, slave WSDs will cease transmitting within five seconds of discovering that they can no longer receive updates from their serving master WSD.

Ofcom's permanent location-specific adjustments

- If necessary, Ofcom can **make permanent location-specific adjustments** (which would be transmitted to all databases).

PREVIOUS DECISIONS

Application to TV white spaces

- Conclusion from the previous consultations and statements.
  - **license-exempt access to the UHF TV band**
  - **the need to minimise the risk of harmful interference to the incumbent users**, namely DTT and PMSE
- Decision from the previous consultations
  - to allow WSDs access to the UHF TV band on a licence-exempt basis subject to ensuring that the probability of harmful interference to existing licensed services, including DTT and PMSE, would be low.

http://stakeholders.ofcom.org.uk/consultations/geolocation/statement/
http://stakeholders.ofcom.org.uk/consultations/ddr/statement/.

PROPOSALS IN THIS DOCUMENT IMPLEMENT PREVIOUS DECISIONS

Purpose of this consultation

- To set out the Proposed approach to the spectrum management decisions
  - proposals for the parameters and algorithms that will determine the available frequencies and powers (TVWS availability) for use by WSDs in Ofcom TVWS framework (the coexistence proposals).
  - to ensure a low probability of harmful interference to other services using the UHF TV band or adjacent bands. They will also determine the total availability of TVWS spectrum.

WHITE SPACES PILOT AND FULL SOLUTION

Pilot and full solution

- **the pilot**: from the 4th quarter of 2013 to the end of the first quarter of 2014.
  - trials at several locations around the UK by a range of different service providers using a variety of different types of devices.
  - to test the systems and processes (including regulatory processes) that will enable WSD operation and allow database providers, service providers and device manufacturers to test their own equipment.
  - For a few specific aspects of the coexistence framework (see for example paragraphs 5.37 to 5.40), to adopt a more limited set of proposals during the pilot
- **full TVWS solution nationwide**: the third quarter of 2014.

NEXT STEPS

Timeline for coexistence framework

- consultation period: ~ Friday 15 November 2013
- test the proposals to the extent practicable in our upcoming pilots: 4th quarter of 2013
- further comments by stakeholders during the course of the pilot and shortly thereafter
- review the results of the trials in the pilot and responses to this consultation to inform a Statement: summer 2014
- update our interference management processes: before launching full solution
- launch the full solution for WSDs in the UHF TV band: 3th quarter of 2014
- review Ofcom's coexistence proposals with real life experience post-launch : no later than 18 months after the launch of the full solution

STRUCTURE OF THE CONSULTATION DOCUMENT

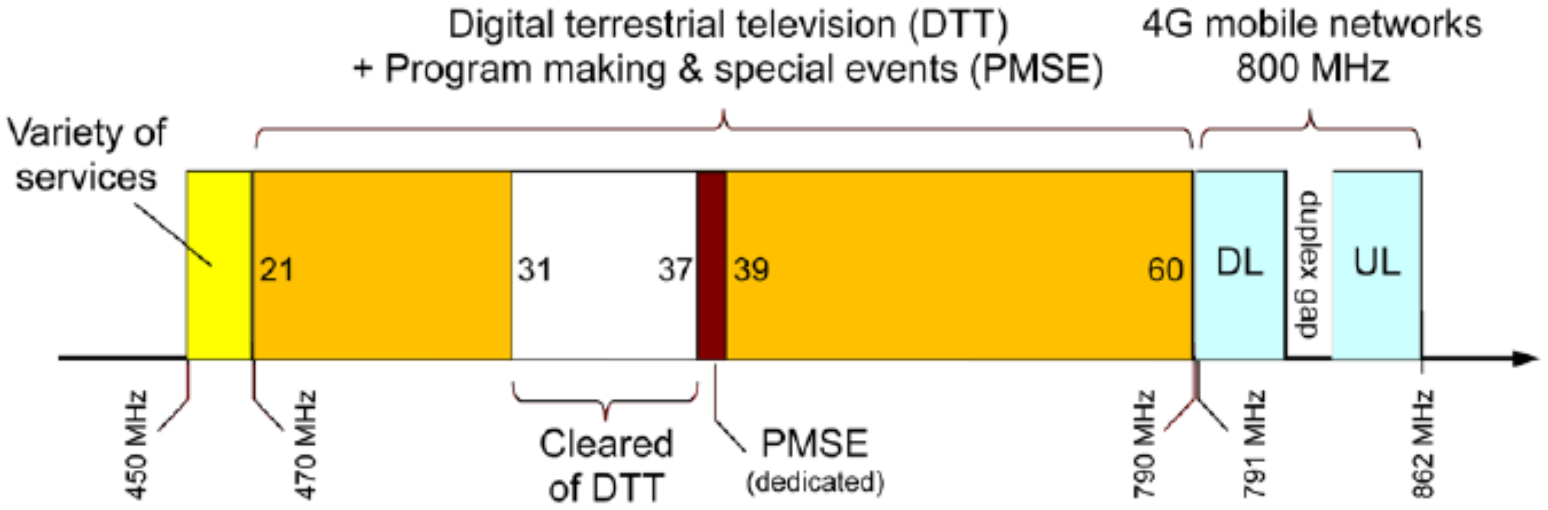
- Section 3: the coexistence issues;
- Section 4: high level approach to addressing coexistence issues;
- Section 5: proposals for WSD coexistence with DTT services;
- Section 6: proposals for WSD coexistence with PMSE services;
- Section 7: proposals for WSD coexistence with other services.

Ofcom has published a **technical report** alongside the consultation document which details the technical work carried out in developing our coexistence proposals.

- Ofcom is seeking responses with evidence to the questions in both this consultation document and the technical report.

WHAT TV WHITE SPACES ARE IN UK

- The UK's DTT network is made up of more than a thousand transmitter masts.
  - between 470 MHz and 790 MHz.
  - dedicated nationwide allocation of channel 38 to PMSE.



- White spaces: unutilised frequences

Figure 3 – Snapshot of White Space spectrum in most of London

POTENTIAL CHANGES TO THE UHF TV BAND

- Under consideration of future potential use of the 700 MHz band (694-790MHz) for mobile data use
  - to result in less white space in the remaining TV frequencies.
- In the longer term, Ofcom may look to expand the range of frequencies that can be used by WSDs beyond those in the UHF TV band.
  - In principle, this could create other opportunities which may counterbalance the potential reduction in white space availability due to the 700 MHz release.

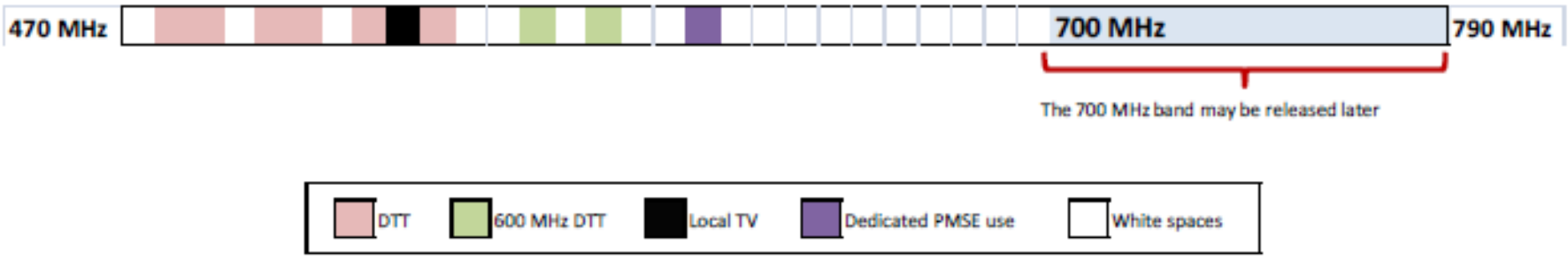


Figure 4 – Future changes in DTT spectrum, London, Illustrative example.

COEXISTENCE ISSUES

Main goal

- to ensure that there is a low probability of harmful interference to
  - DTT,
  - PMSE and
  - services in adjacent bands.
- This can be achieved by enabling calculation of
  - the **frequencies** at which WSDs are allowed to operate, and
  - the **amount of power** at which a WSD can transmit in each frequency,

  accounting for:
  - services which are close in frequency to white space spectrum;
  - services from multiple DTT transmitters; and
  - PMSE, which varies in location and frequency.

COEXISTENCE WITH SERVICES CLOSE IN FREQUENCY

- WSDs can operate at higher power where there is greater frequency separation.

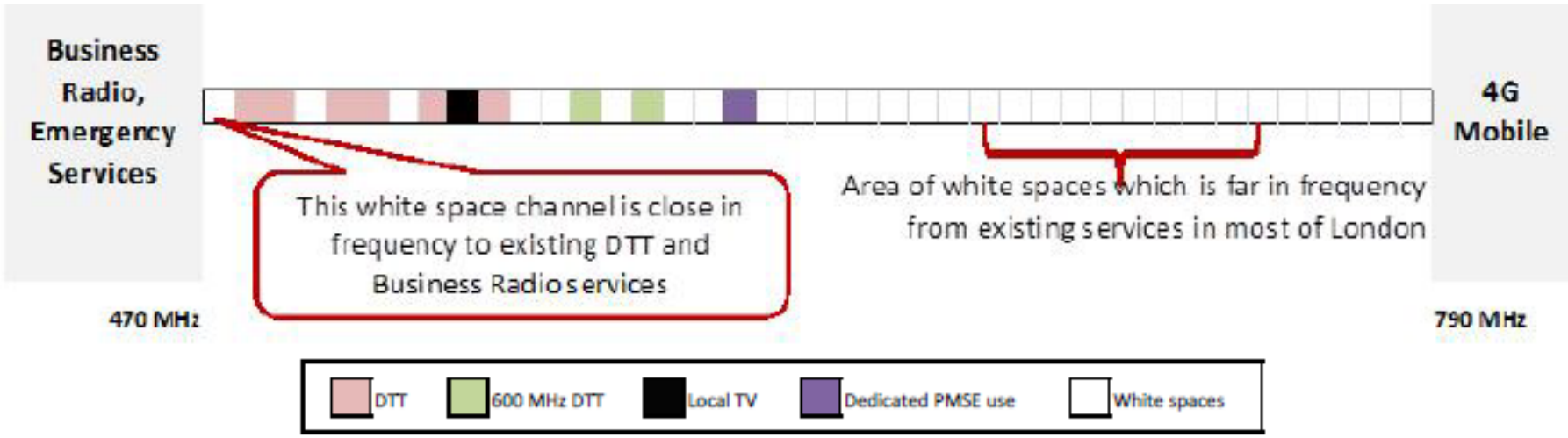


Figure 5 – White spaces and adjacent services, London snapshot example

COEXISTENCE WITH SERVICES FROM MULTIPLE DTT TRANSMITTERS

- WSDs need to take account not just of the frequencies used for TV reception within their location, but, potentially, also the frequencies used for TV reception in other locations nearby.
  - WSDs in or close to parts of Slough may need to take into account the channels used in Hannington as well as those in the Crystal Palace area, so that they do not interfere with DTT services received from either transmitter.

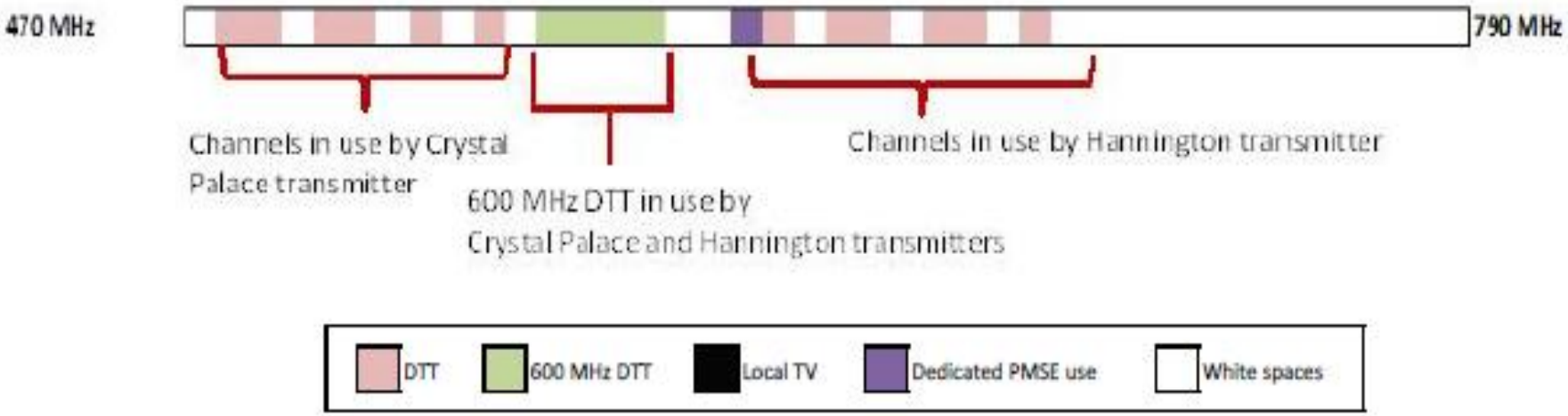


Figure 6 – Illustrative example in Slough in the border of London / Hannington TV regions, (only channels in current use shown)

COEXISTENCE WITH A SERVICE THAT VARIES IN PLACE AND FREQUENCY (PMSE)

- The white space spectrum is currently utilised in a time-varying fashion by several wireless audio applications, including microphones and in-ear monitors.
  - This use will impact white space availability, although channels used and locations of use will vary.

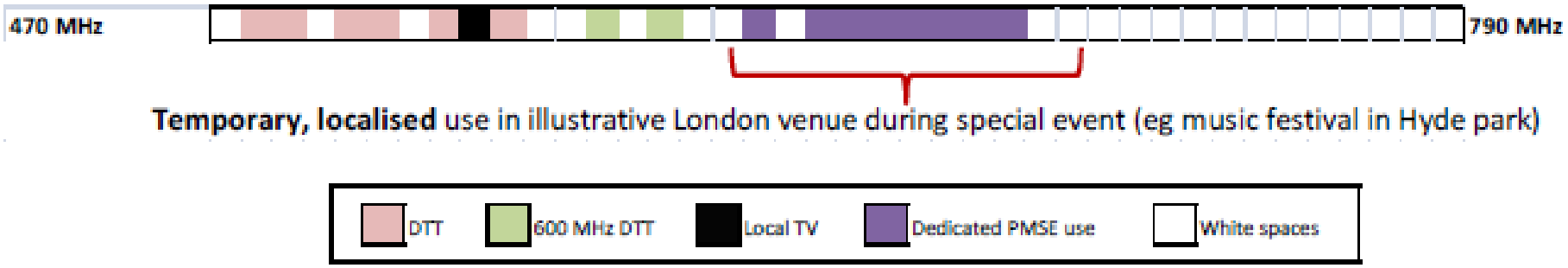


Figure 7 – Illustrative example usage during a hypothetical event in Hyde Park

ENSURING A LOW PROBABILITY OF HARMFUL INTERFERENCE

- In ensuring a low probability of harmful interference from WSDs to services in and adjacent to the UHF TV band, two aspects have been considered
  - the **maximum power of WSDs** and
  - how to account for different **types of WSDs**.

CALCULATING POWER ALLOWED FOR A DEVICE

- No WSD at any location can **operate at a power greater than 36 dBm/(8 MHz).**
  - The limit the Federal Communications Commission has imposed in the US for WSD deployment.
  - This maximum WSD power level will then be reduced, where necessary, taking into account a number of parameters.

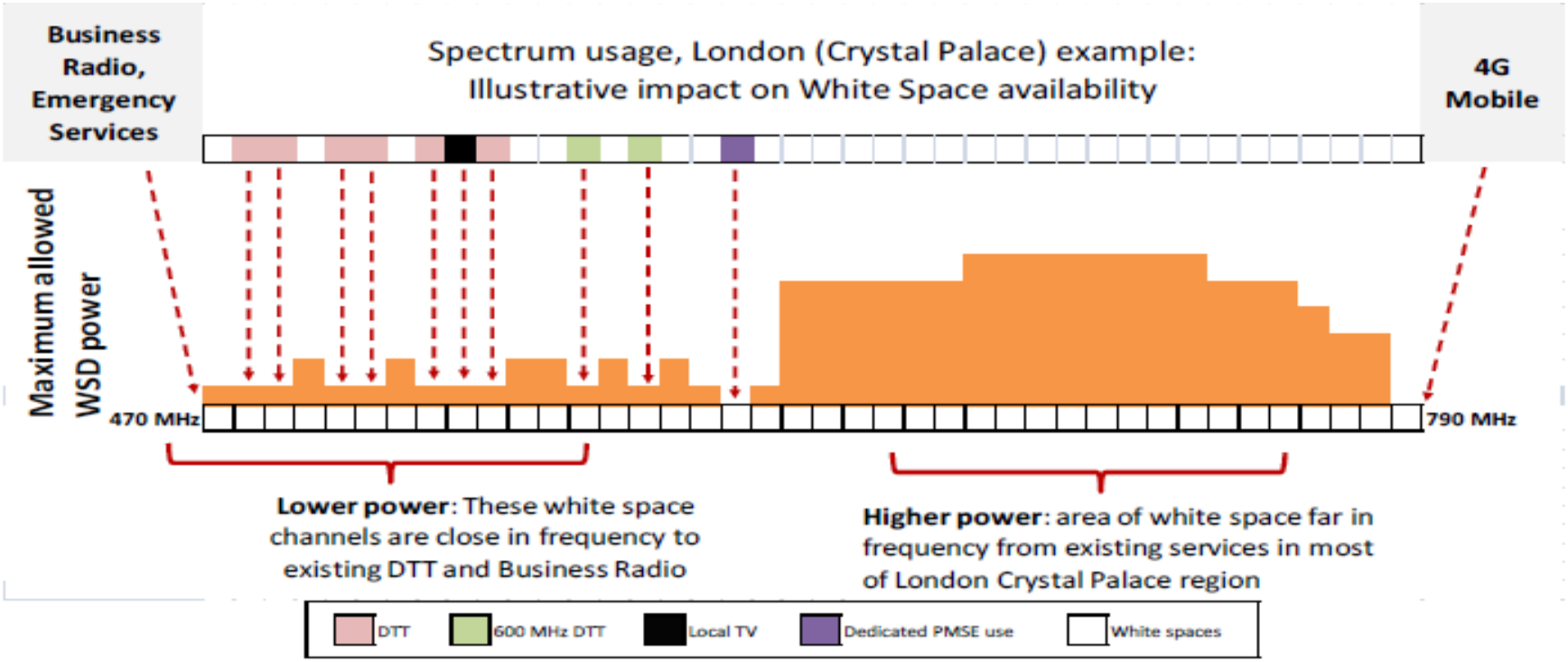


Figure 8 – How the coexistence proposals will determine White Space availability –Illustrative example.

ACCOUNTING FOR DIFFERENT TYPES OF WSD (1)

- Databases will need to treat different types of WSD differently.

Three types of distinction

- two overall types of devices
  - type A (fixed location)
  - type B (portable/mobile)
- five different spectrum emission masks.
  - each of these may conform to up to **five different spectrum emission masks**.
- three “protection ratio” categories
  - to consider the impact from **different radio technologies**
  - by differentiating devices by **three “protection ratio” categories**

- In the pilot only the first and second variations will be taken account of
  - so there will be ten different categories of device.

ACCOUNTING FOR DIFFERENT TYPES OF WSD (2)

- Five different spectrum emission masks: five classes.
  - each of these may conform to up to **five different spectrum emission masks**.

Table 2.2 – Adjacent frequency leakage ratios (AFLR) for different device classes.

Where P_{OOB} falls within the ΔF^{th} adjacent 8 MHz DTT channel	AFLR (dB)				
	Class 1	Class 2	Class 3	Class 4	Class 5
$\Delta F = \pm 1$	74	74	64	54	43
$\Delta F = \pm 2$	79	74	74	64	53
$\Delta F \geq +3$ or $\Delta F \leq -3$	84	74	84	74	64

COEXISTENCE FRAMEWORK AND APPROACH (1)

- **The coexistence algorithms and parameters (coexistence proposals)** need to be defined initially in the absence of extensive practical experience.
  - so the implications remain uncertain.
- Some of the sources of uncertainty
  - a number of proposed use cases for WSDs
  - Unclear future technical performance of WSDs
  - Unknown pace of future deployment of WSDs
  - modelling interference is a complex task.
- Geolocation database approach
  - To overcome these uncertainty
- An initially cautious approach adopted in setting the coexistence proposals
  - to relax parameters (and increase the amount of available white space) in the future
  - by default a device will be assumed to be in the worst technology category
  - **This cautious approach at this stage will not create spectrum constraints which are too restrictive and prevent WSD deployment.**

COEXISTENCE FRAMEWORK AND APPROACH (2)

Two stages of evaluation of the framework

- The pilot
  - The pilot will allow participants with an interest in launching WSDs or WSDBs to **test them in fixed areas**, and will enable Ofcom to evaluate the processes underpinning the overall framework for WSD regulation.
  - **power levels and frequencies** to be used by the WSDs will be determined
  - updated proposals in a Statement will be published in summer 2014.
- The full solution
  - Will be launched in the 3th quarter of 2014.
  - to allow further learning **from real life experience,**
  - further review will occur no later than 18 months after launch

HOW OFCOM WILL ADDRESS SHORT TERM INTERFERENCE ISSUES

- While the coexistence proposals set out in this document are cautious and likely to result in very few cases of harmful interference, **we must be prepared to react if any harmful interference does occur.**
- This includes
  - immediate reaction to individual cases and
  - the ability to review proposals in reaction to a systemic pattern of cases.

IMMEDIATE REACTION TO INTERFERENCE

- **Processes for reacting to interference complaints from DTT viewers and PMSE users** to account for the possibility of interference caused by WSDs.
  - WSDB providers have obligations to support the interference management functions.
- This process involves
  - **organisations operating existing helplines** that receive interference complaints from DTT viewers
  - **WSDBs** which would be used to check for WSD presence at the location of the complaint.
  - **tests** to establish whether WSDs are likely to be the source of a specific instance of interference
  - **permanent, localised adjustments** will be made to white space availability.
- Adjustments may be made for a single 100 metre x 100 metre pixel or for multiple pixels.

WSD COEXISTENCE WITH DTT SERVICES (1)

Viewers using rooftop level aerials

- DTT planning has generally sought to ensure that almost all of the UK population is covered from a DTT transmitter,
- The coexistence proposals for white spaces should in practice **maintain the current level of coverage achieved by the DTT network today,** while ensuring a low probability of harmful interference.

Viewers using indoor aerials

- More likely to be affected by interference from other sources.
- It is not for Ofcom to take measures to minimise the risk of interference to indoor aerial reception.
- **Algorithms or parameters that are designed specifically to ensure a low probability of harmful interference to indoor aerials for receiving DTT have not been developed.**

WSD COEXISTENCE WITH DTT SERVICES (2)

Viewers using alternative transmitters

- Viewers in many areas receiving signals from more than one transmitter.
- It is the householder's responsibility to ensure that it has an adequate aerial and receiver installation, and that it should ensure its aerial is aligned with the best transmitter for their location,.
- **White space availability should in general be calculated taking into account only the planned transmitter(s) for any given location**.

WSD COEXISTENCE WITH DTT SERVICES (3)

Ensuring a low probability of harmful interference to DTT services – technical summary

- Section 4 of the Technical Report provides details.
- **Location probability** is calculated: the probability with which a DTT receiver would operate correctly at a specific location.
  - The presence of any interferer results in a reduction in location probability.
- The objective of a low probability of harmful interference to DTT can be met by **setting emission limits for WSDs such that there is only a 10% likelihood that the rise in the noise-plus-interference floor exceeds 1 dB at the edge of DTT coverage.**
  - equivalent to a 7 percentage point reduction in location probability
- Two types of the statistics considered
  - The statistics of radio propagation from WSDs to DTT receivers (WSD-DTT coupling gains) and
  - the statistics of DTT receiver performance (WSD-DTT protection ratios):
    - The **protection ratio** defines the ratio of wanted power to unwanted power at the point of receiver failure.
    - three categories of protection ratios: “high”, “medium”, and “low”.
    - We will not however implement the protection ratio category approach for the pilot

FOUR WSD DEPLOYMENT SCENARIOS

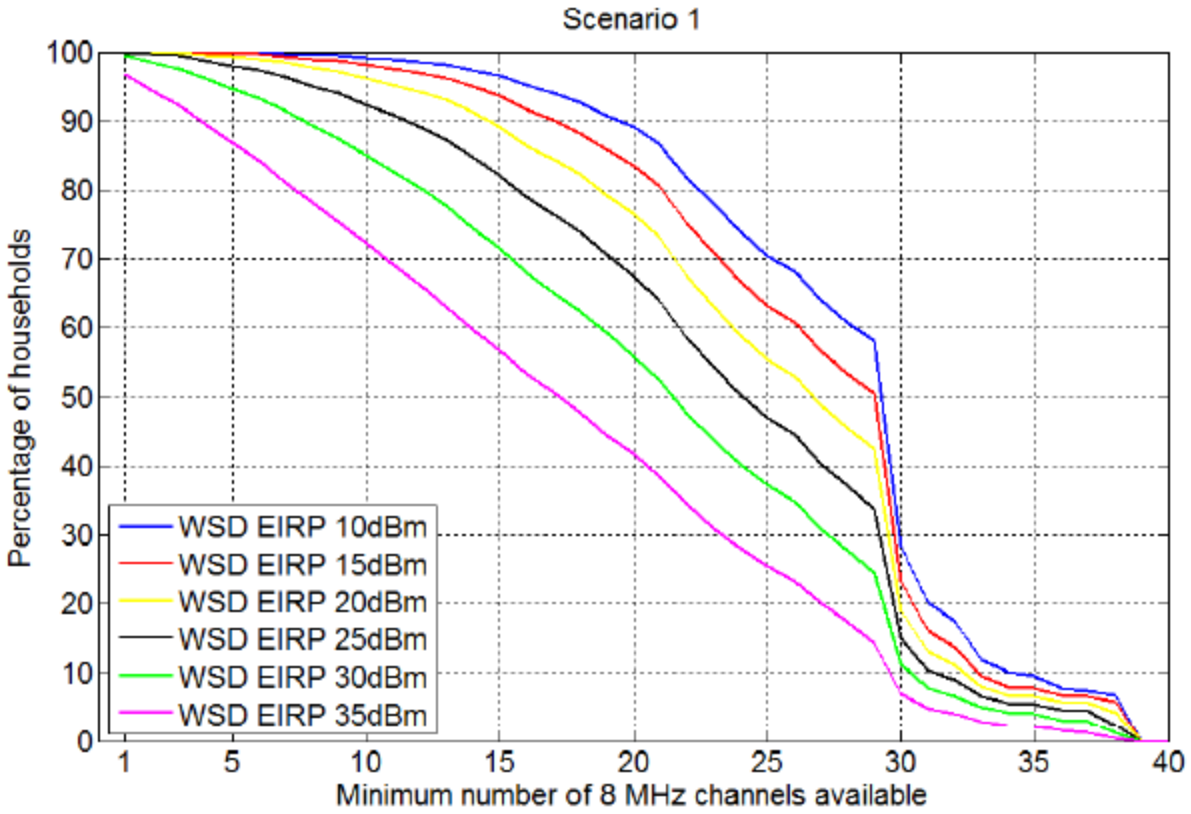
Table 1 – Scenarios examined for UK-wide TVWS availability.

Scenario	WSD type	WSD class	WSD antenna height (metres)	Use case (geolocated WSD)
1	A	1	15	Base station
2	A	4	10	CPE with roof-top antenna
3	A/B	4	1.5	Access point
4	A/B	5	1.5	Portable/mobile device

The WSD class identifies the extent to which the emissions of a WSD leak into adjacent channels (class 1 represents least leakage).
Availability checked at every 100 metre × 100 metre pixel in the UK.

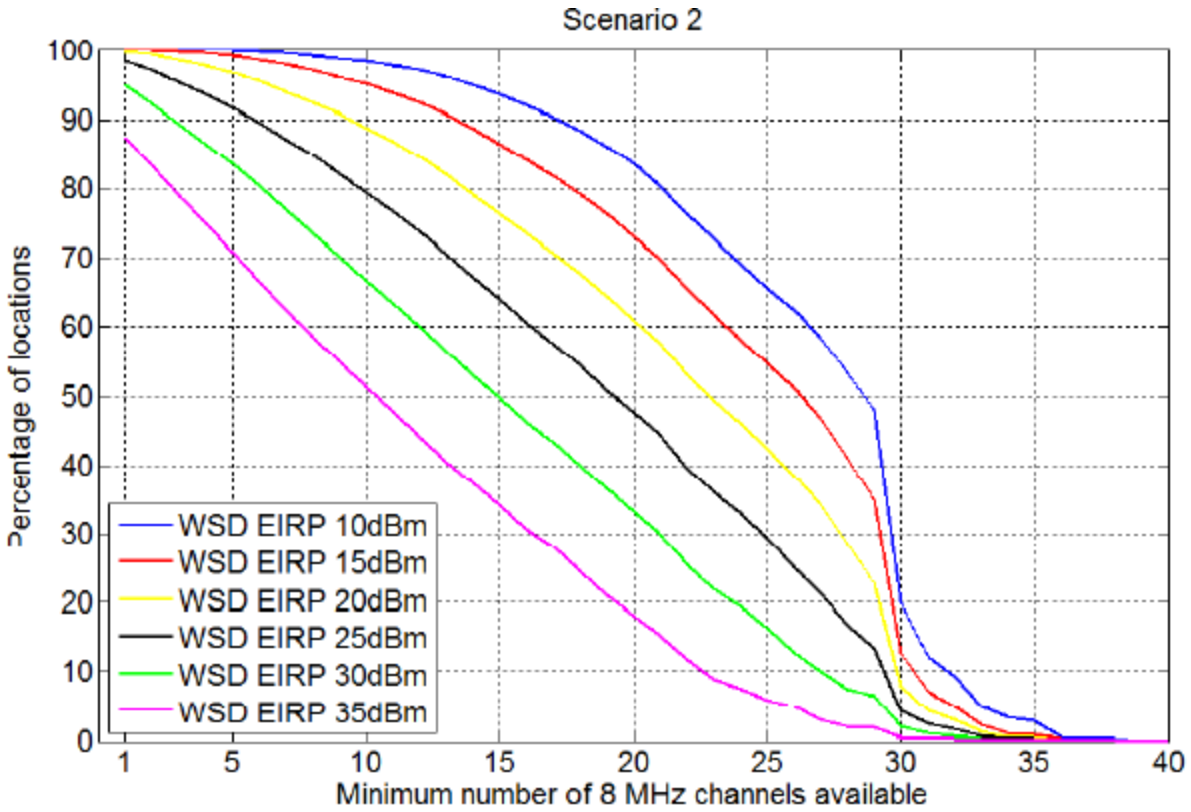
TVWS AVAILABILITY UK-WIDE (1)

Figure 9 – UK-wide TVWS availability for scenario 1. Class 1 WSD with an antenna height of 15 metres.



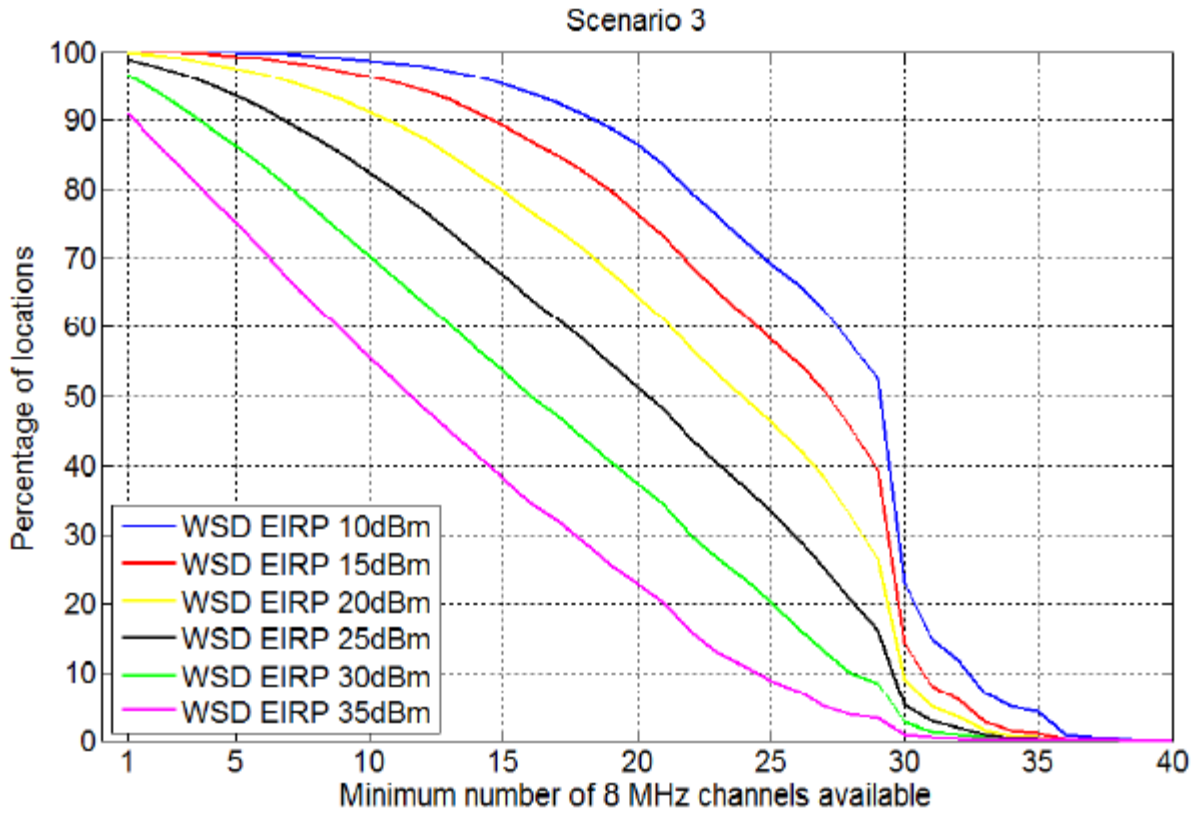
TVWS AVAILABILITY UK-WIDE (2)

Figure 10 – UK-wide TVWS availability for scenario 2. Class 4 WSD with an antenna height of 10 metres.



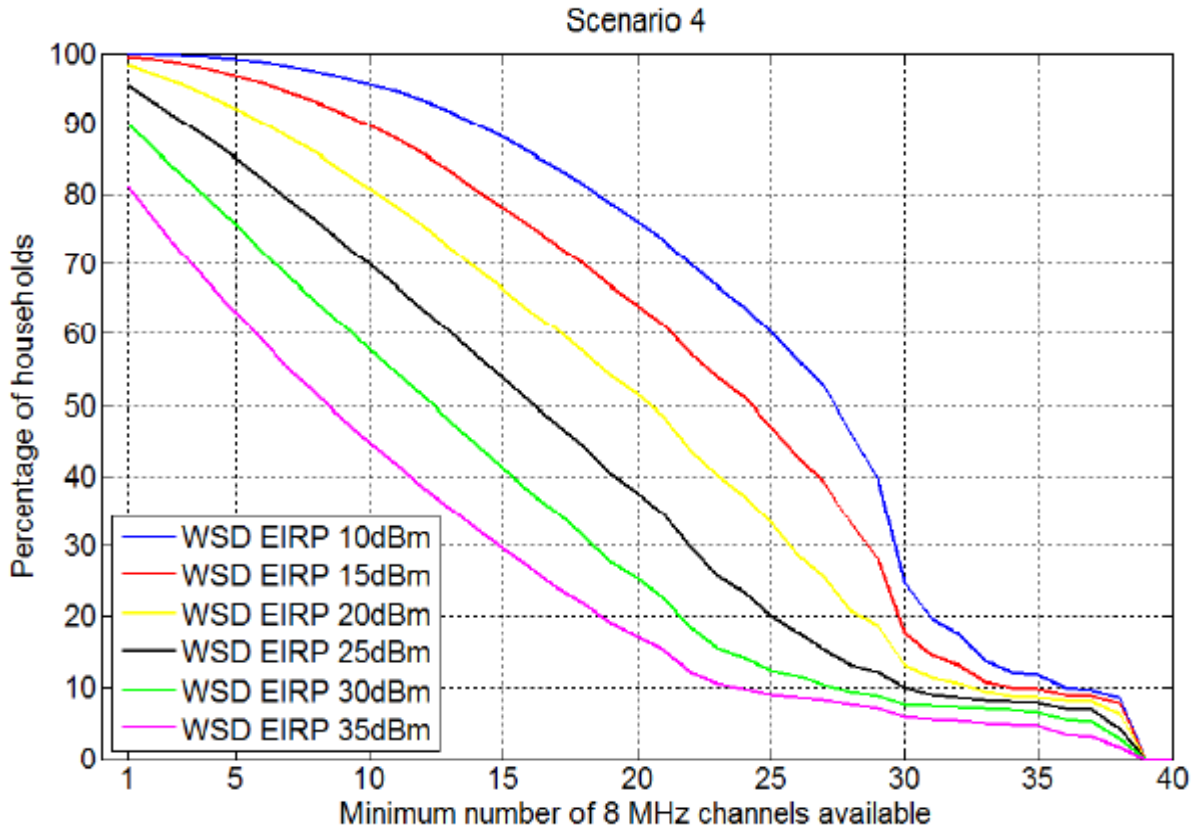
TVWS AVAILABILITY UK-WIDE (3)

Figure 11 – UK-wide TVWS availability for scenario 3. Class 4 WSD with an antenna height of 1.5 metres.



TVWS AVAILABILITY UK-WIDE (4)

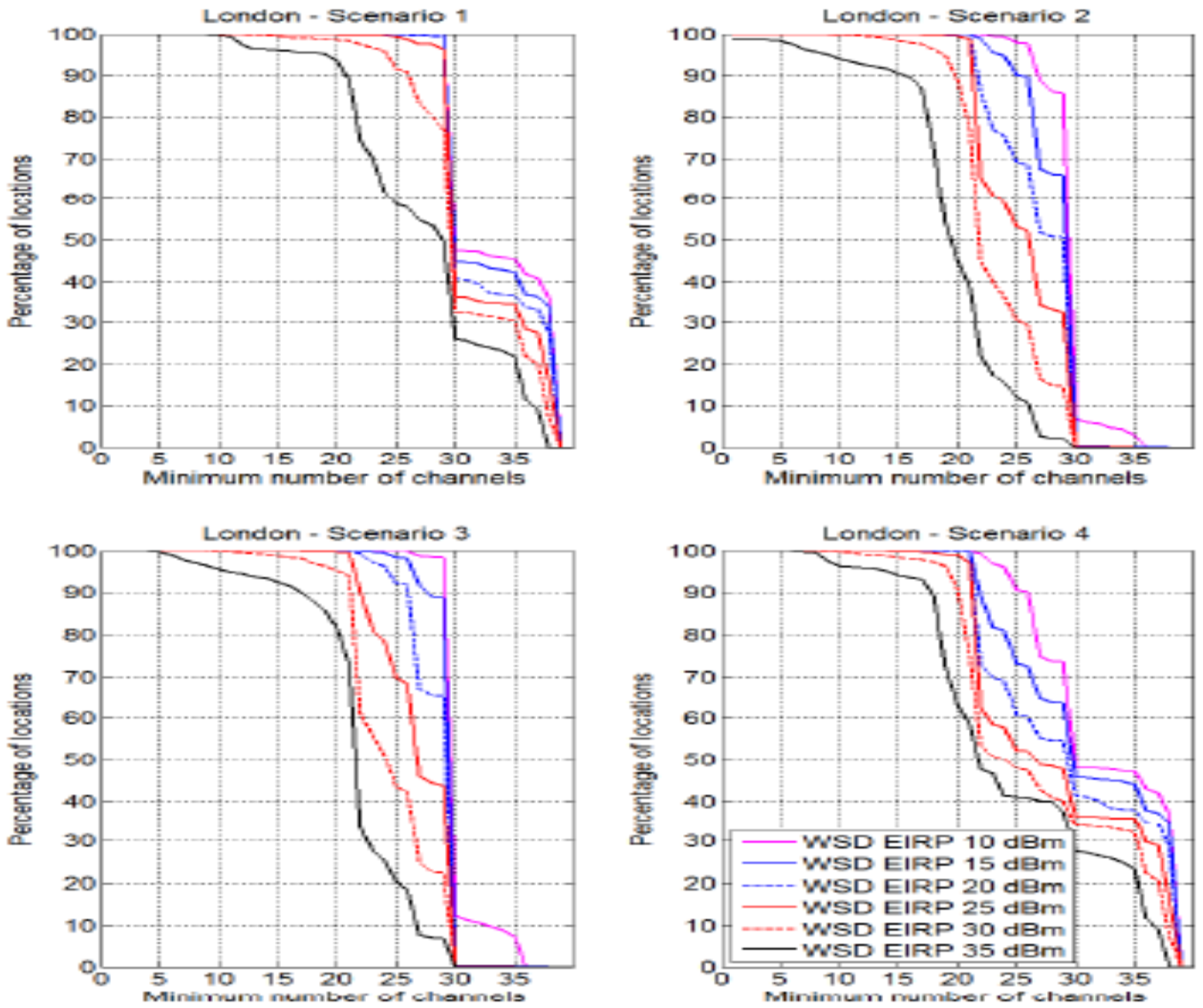
Figure 12 – UK-wide TVWS availability for scenario 4. Class 5 WSD with an antenna height of 1.5 metres.



TVWS AVAILABILITY IN LONDON

Figure 13 – Availability of 8 MHz channels in Central London in relation to DTT.

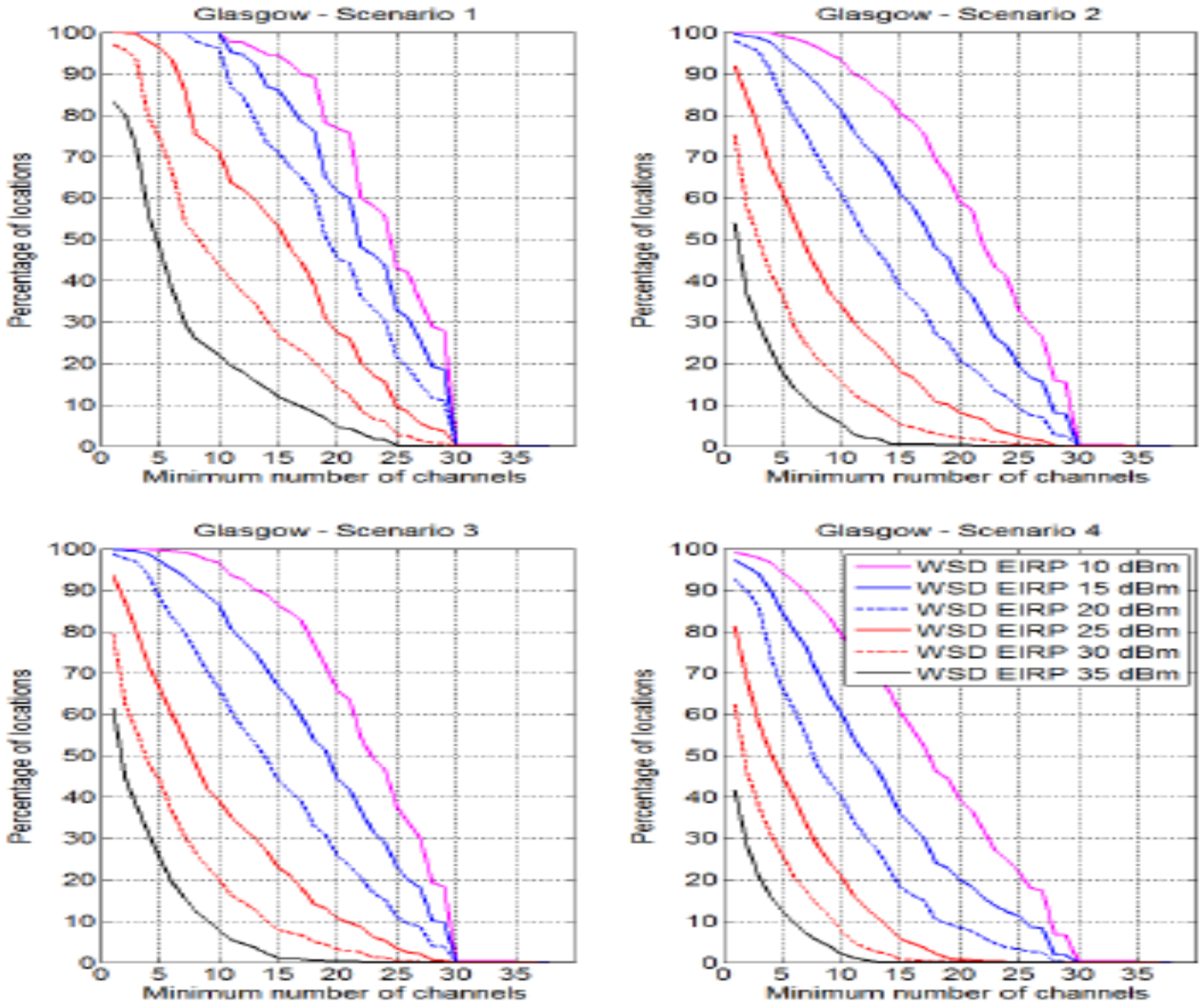
Availability in 10 km × 10 km areas of London and Glasgow



TVWS AVAILABILITY IN GLASGOW

Figure 14 – Availability of 8 MHz channels in Glasgow in relation to DTT.

Availability in 10 km × 10 km areas of London and Glasgow



WSD COEXISTENCE WITH PMSE SERVICES ()

PMSE use of the UHF TV band – implementation proposals

- Five main PMSE services:
  - wireless microphones, in-ear monitors, talkback, programme audio links, and data links.
- The licences issued are location-specific and time-bound.
  - One exception to this is channel 38 (606 – 614 MHz): licensed, but not location-specific.
  - News gathering is one service.
- It is proposed to restrict WSD operation wherever **licensed PMSE services** are in use.
  - Due to the fact that PMSE services can operate at any location using channel 38, these restrictions **will also apply to channel 38 at all locations**.

WSD COEXISTENCE WITH PMSE SERVICES (2)

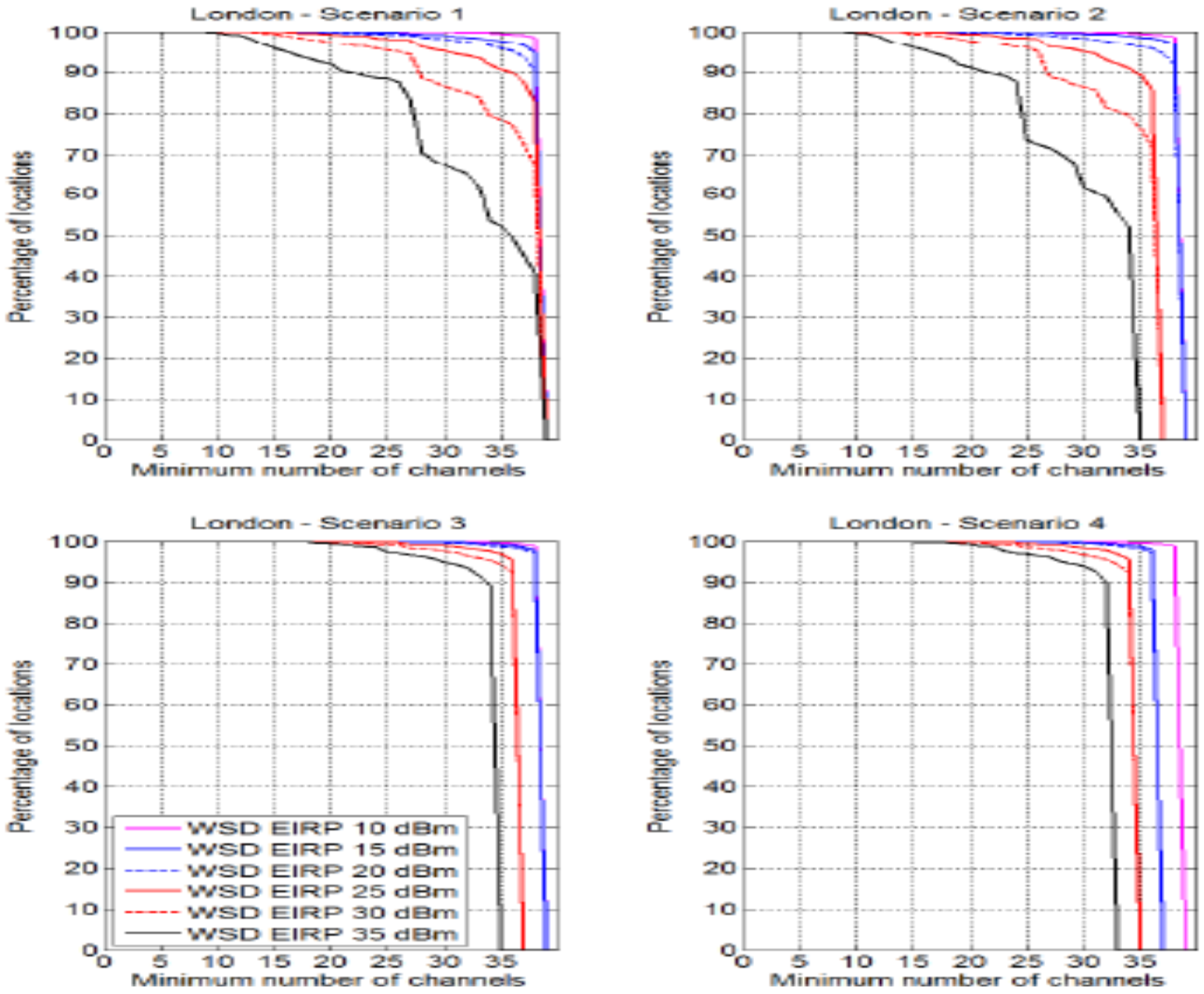
Ensuring a low probability of harmful interference to PMSE services

- Section 5 of the Technical Report provides details.
- By limiting the power of WSDs so that the WSD signal power received at the PMSE receiver is less than the wanted signal power by a specified protection ratio.
- three types of variables considered:
  - *The wanted signal power at the PMSE receiver.*
  - *The protection ratio.*
  - *The level of interfering signals at the PMSE receiver.*
- Unlike DTT, it is **not proposed to use multiple categories of protection ratio for PMSE**.
- It is the **leakage of emissions from WSDs into the PMSE channel** that is the dominant source of interference.
- PMSE usage in all channels 21 to 60 (with the exception of channel 38) is subject to a location-specific licence, meaning the permitted location of the PMSE use is known and is recorded.
- PMSE usage in channel 38 is subject to a UK-wide shared licence issued by JFMG, meaning the location of the PMSE use is unknown.
  - WSDs will not be able to use channel 38 in any location and there will be restrictions nationwide in neighbouring channels.

TVWS AVAILABILITY IN LONDON (1)

Figure 15 – TVWS availability in Central London in relation to PMSE.

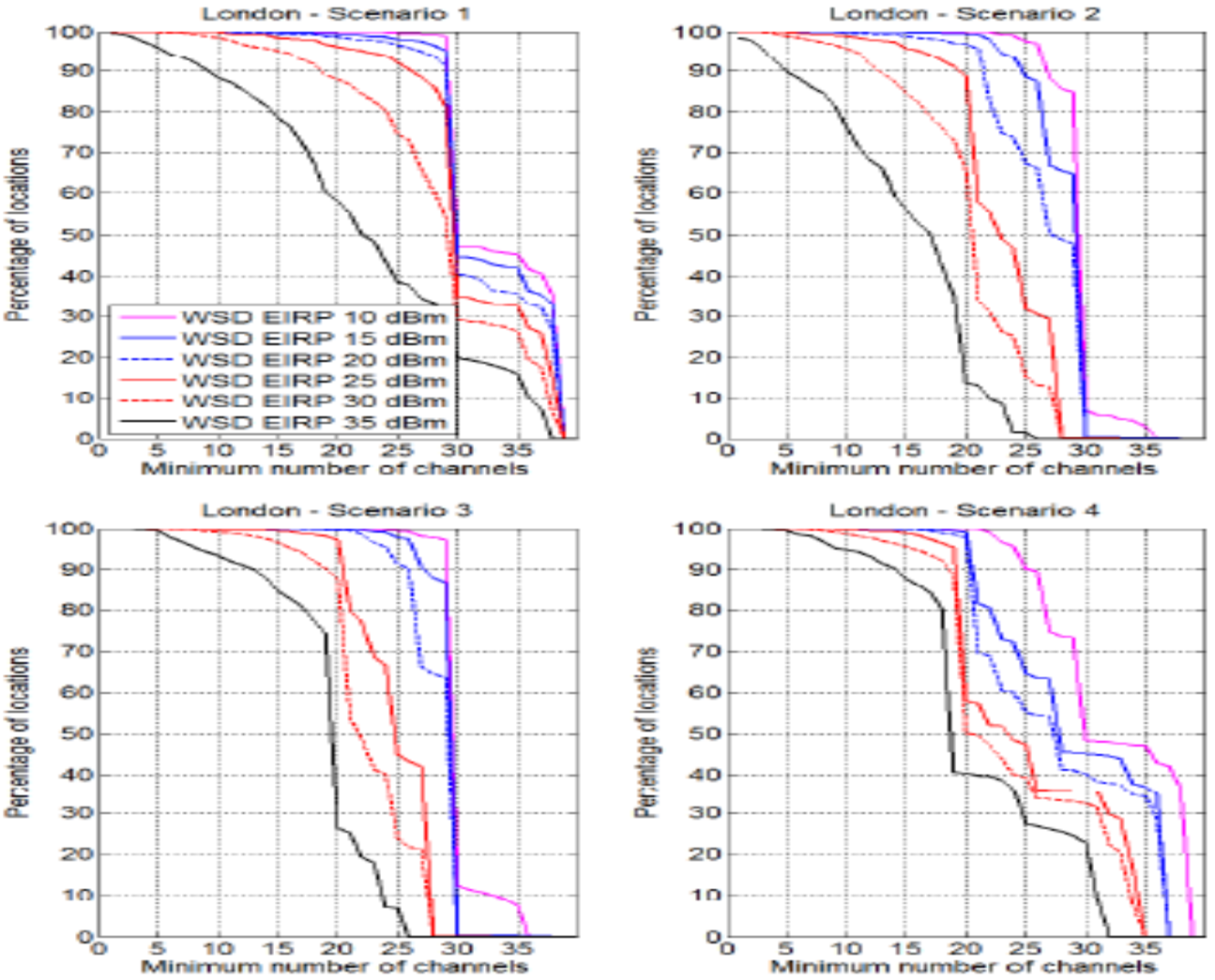
Availability in 10 km × 10 km areas of London and Glasgow



TVWS AVAILABILITY IN LONDON (2)

Figure 16 – TVWS availability in Central London in relation to DTT and PMSE.

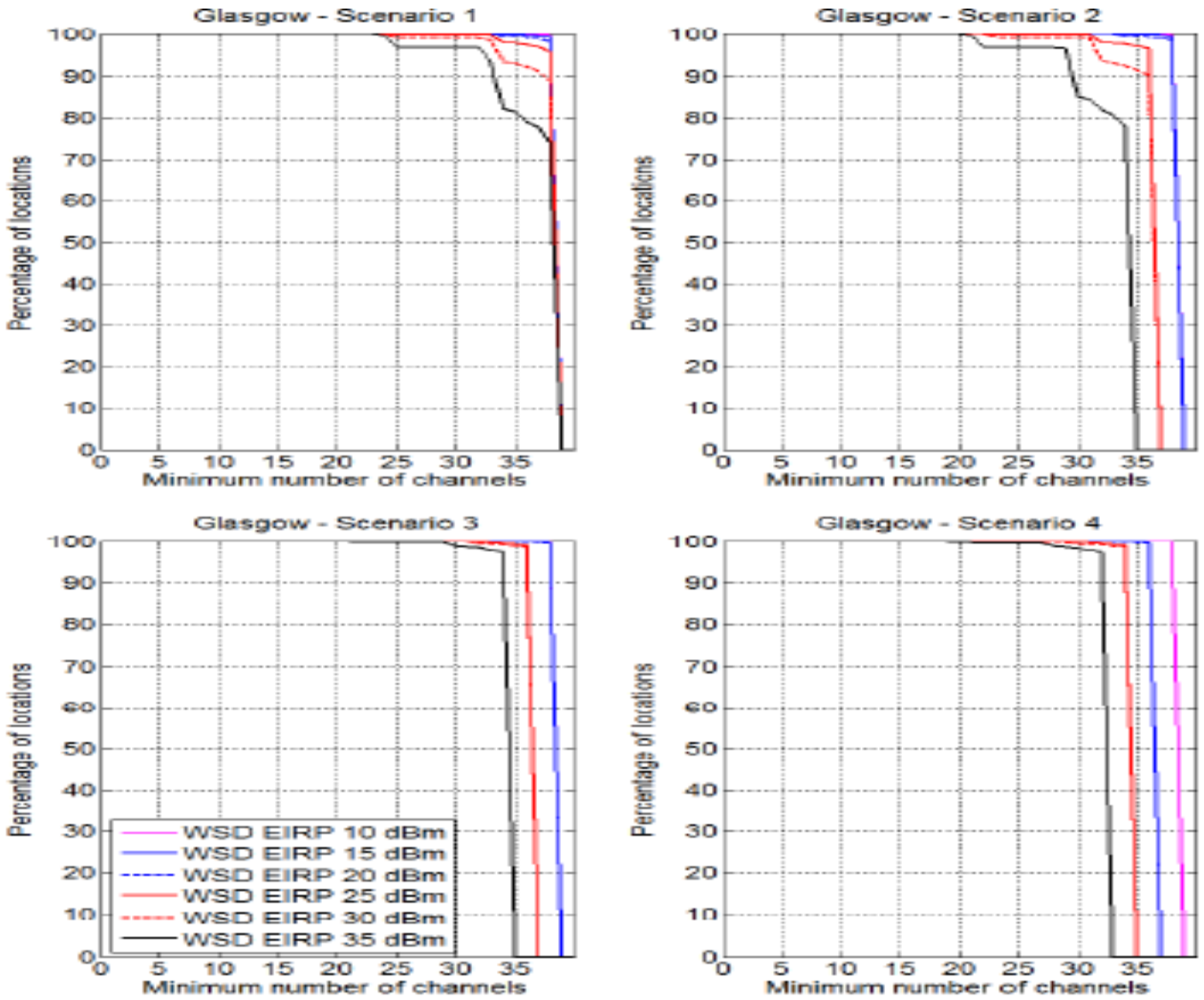
Availability in 10 km × 10 km areas of London and Glasgow



TVWS AVAILABILITY IN GLASGOW (1)

Figure 17 – TVWS availability in Glasgow in relation to PMSE.

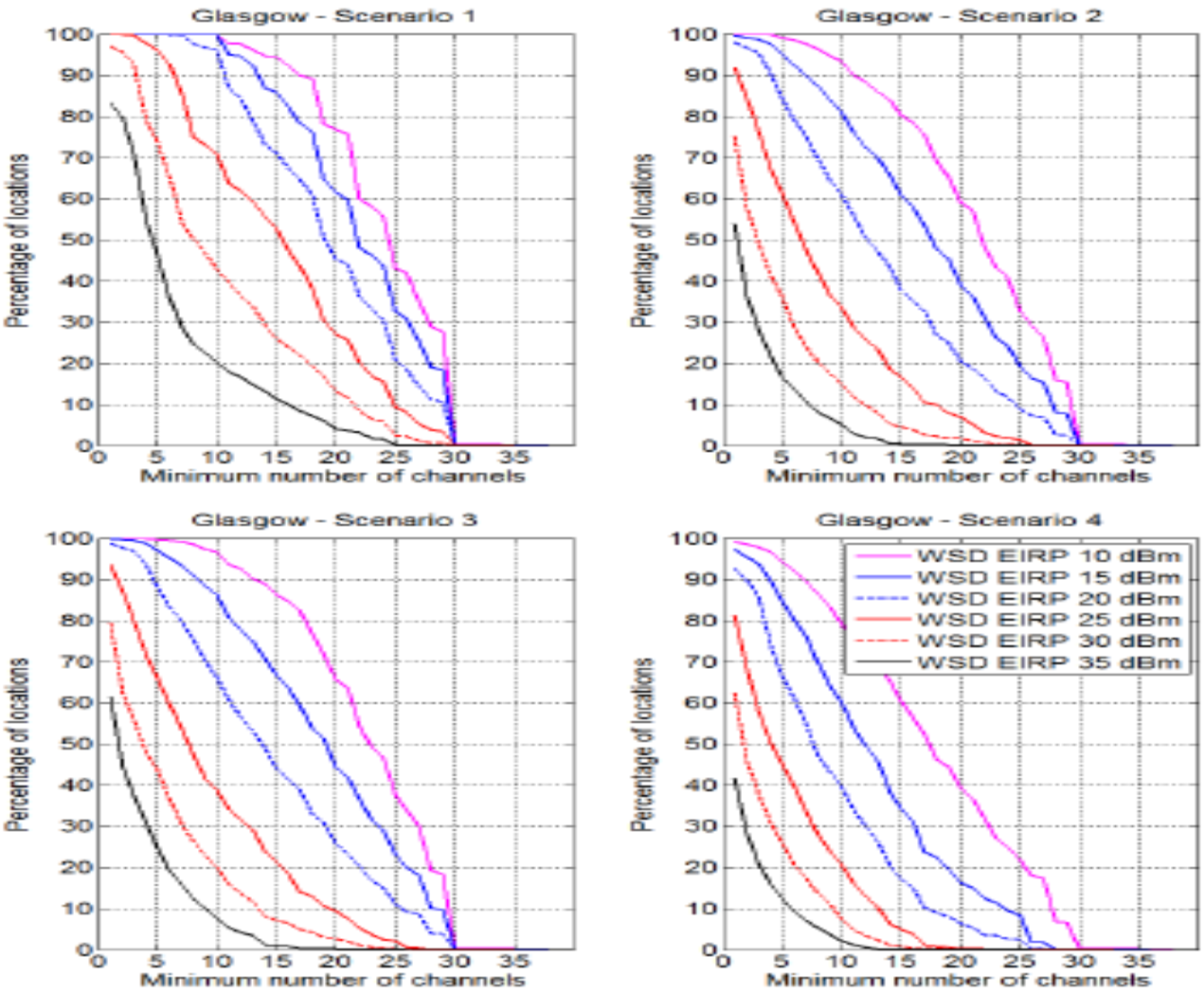
Availability in 10 km × 10 km areas of London and Glasgow



TVWS AVAILABILITY IN GLASGOW (2)

Figure 18 – TVWS availability in Glasgow in relation to DTT and PMSE.

Availability in 10 km × 10 km areas of London and Glasgow



OTHER COEXISTENCE ISSUES (1)

Other services in UHF TV band

- 4G services: 800 MHz band (791 MHz – 862 MHz)
  - For 4G mobile deployment.
- Services below the UHF TV band: 450 MHz - 470 MHz
  - used for business radio, PMSE, scanning telemetry, short range devices, and maritime, Prison Service, and Revenue and Customs purposes.
- Cable services
  - Cable equipment, unlike wireless equipment, does not use an antenna to receive radio signals and therefore is inherently more robust to interference.
- Cross-border implications
  - The UHF TV band is in use primarily for DTT in neighbouring countries.

OTHER COEXISTENCE ISSUES (2)

4G services – implementation proposals

- Section 6 of the Technical Report presents this analysis in more detail.
- focused the technical analysis on the potential for harmful interference from WSDs to mobile stations
- Implemented by ensuring that mobile stations are not subject to interference greater than that from base stations in adjacent channels.

→ **A guard band at channel 60 is proposed, meaning that no WSD could operate using that channel**

OTHER COEXISTENCE ISSUES (3)

Services below the UHF TV band – implementation proposals

- A large number of different users of spectrum close to the lower end of the UHF TV band, between 450 MHz and 470 MHz (known as the UHF 2 band).
- **By placing power restrictions on WSDs operating in the lower section of the UHF TV band (in channels 21 to 24).**

Table 7.5. WSD in-block EIRP must not exceed (17 – *x*) *dBm/(100 kHz)* or (36 – *x*) *dBm/(8 MHz)*

x (dB)	DTT channel			
	21	22	23	24
Class 1	6	1	0	0
Class 2	6	6	6	0
Class 3	8	6	0	0
Class 4	8	8	6	0
Class 5	8	8	8	6

- These restrictions would however not be required if the draft ETSI harmonised standard EN 301 598 was amended.

Figure 7.3 – Proposed tightening of the unwanted emission limit over 230-470 MHz in draft EN 301 598.

OTHER COEXISTENCE ISSUES (4)

Cable services issues

- Cable networks are different to wireless technologies such as DTT, PMSE and WSDs. They do not use spectrum and therefore **Ofcom does not take them into account in our spectrum planning decisions.**

OTHER COEXISTENCE ISSUES (5)

Cross-border issues

- GE06 Plan: to protect DTT services in signatory countries by ensuring cross border emissions do not exceed certain levels.

Table 2 – GE06 co-ordination trigger levels.

Broadcasting System Modifying the Plan	Trigger Field Strength (dB(μV/m))		
	Band IV - CH's 21-34 (470-582MHz)	Band V - CH's 35-51 (582-718MHz)	Band V - CH's 52-69 (718-862MHz)
DVB-T	21 dBμV/m	23 dBμV/m	25 dBμV/m

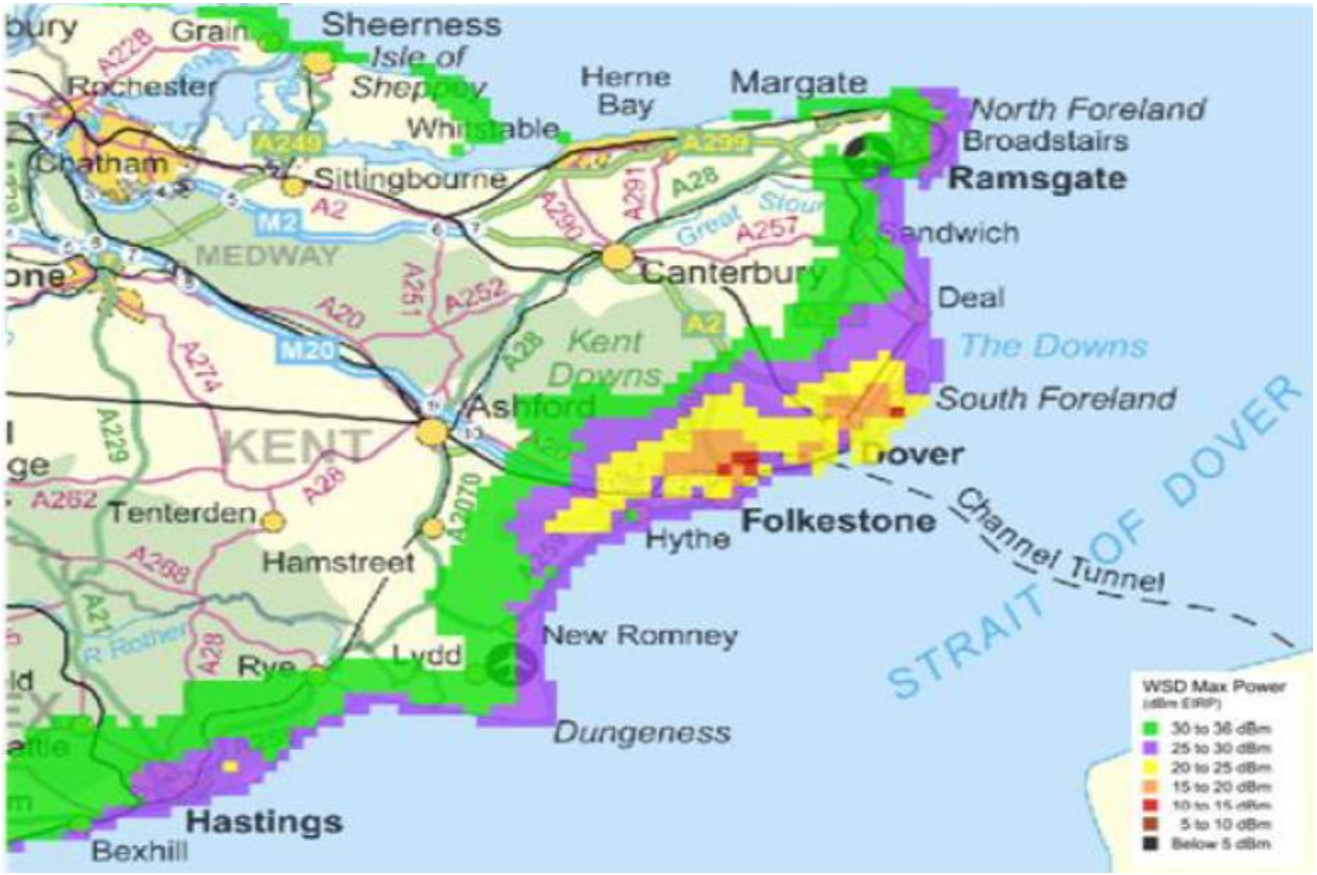
- Ofcom has calculated restrictions on WSD powers based on the GE06 international co-ordination trigger levels of Table 2 and for a representative number of WSD antenna heights.
- Figure 19 and Figure 20 show the resulting WSD power restrictions in the areas near the Isle of Wight and Dover.

CONSEQUENCES OF OUR PROPOSALS FOR WHITE SPACE AVAILABILITY (1)

Figure 19 – TVWS availability on the Isle of Wight in channel 21 with a WSD antenna height of 10 metres.

CONSEQUENCES OF OUR PROPOSALS FOR WHITE SPACE AVAILABILITY (2)

Figure 20 – TVWS availability near Folkestone and Dover in channel 21 with a WSD antenna height of 10 metres.



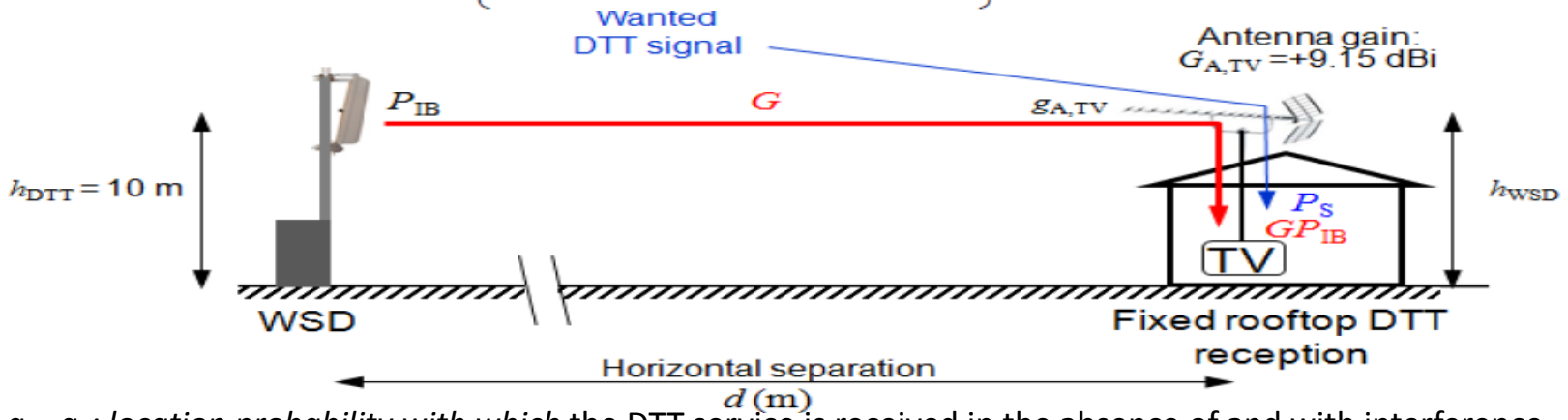
CONSULTATION QUESTIONS GENERAL

- *Q1: Do you have any comments on our proposed approach to ensuring a low probability of harmful interference to DTT services? Please state your reasons for your comments.*
- *Q2: Do you have any comments on our proposed approach to ensuring a low probability of harmful interference to PMSE services? Please state your reasons for your comments.*
- *Q3: Do you have any comments on our proposed approach to ensuring a low probability of harmful interference to 4G services above the UHF TV band? Please state your reasons for your comments.*
- *Q4: Do you have any comments on our proposed approach to ensuring a low probability of harmful interference to services below the UHF TV band? Please state your reasons for your comments.*

CONSULTATION QUESTIONS TECHNICAL (1)

- *Question T1: Do you have any comments on our proposal to cap the maximum in-block EIRP of all WSDs at 36 dBm/(8 MHz)?*
- *Question T2: Do you have any comments on our proposed approach for calculating WSD emission limits, as expressed in Equation (4.3), in relation to DTT coexistence calculations?*

$$q_2 = q_1 - \Delta q = \Pr\left\{ P_S \geq U + r(\Delta F, m_S)\, G\, P_{IB} \right\} \qquad (4.3)$$



q_1, q_2: *location probability with which* the DTT service is received in the absence of and with interference respectively

PIB: WSD in-block EIRP over 8MHz

r(ΔF, mS): the ratio of the received wanted DTT signal power to the received WSD interferer power at the point of failure of the DTT receiver.

CONSULTATION QUESTIONS TECHNICAL (2)

- *Question T3: Do you have any comments on our proposed approach for dealing with the uncertainty in the locations of DTT receivers in relation to DTT calculations?*
- *Question T4: Do you have any comments on our proposed target of a 10% likelihood of a 1 dB rise in the noise-plus-interference floor at the edge of DTT coverage?*
- *Question T5: Do you have any comments on our proposed approach for calculating coupling gains* in relation to DTT calculations?*
- *Question T6: Do you have any comments on our proposed protection ratios** in relation to DTT calculations?*

*** The coupling gain *is defined as the ratio of the WSD power arriving at the input to a DTT receiver divided by the power radiated by the WSD.***
**** The WSD-DTT protection ratio is defined as the ratio of wanted DTT signal power (in 8 MHz) over unwanted WSD signal power (in 8 MHz) at the point of DTT receiver failure.**

CONSULTATION QUESTIONS TECHNICAL (3)

- *Question T7: Do you have any comments on our proposed approach for dealing with the uncertainty in the locations of WSDs in relation to DTT calculations?*
- *Question T8: Do you have any comments on our proposed approach for calculating WSD emission limits, as expressed in Equation (5.2), in relation to PMSE coexistence calculations?*

$$P_{\mathrm{IB\,(dBm/100\ kHz)}} = P_{\mathrm{S,0\ (dBm/}B)} - r(\Delta F)_{\mathrm{(dB)}} - m_{G\,\mathrm{(dB)}} - \gamma_{\mathrm{(dB)}} - 10\log_{10}(80), \qquad (5.2)$$

- *Question T9: Do you have any comments on the PMSE wanted signal power levels that we propose in relation to coexistence calculations?*
- *Question T10: Do you have any comments on our proposed approach for calculating coupling gains in relation to PMSE calculations*

CONSULTATION QUESTIONS TECHNICAL (4)

- *Question T11: Do you have any comments on our proposed approach for dealing with the uncertainty in the locations of WSDs in relation to PMSE calculations?*
- *Question T12: Do you have any comments on our proposed approach for dealing with the uncertainty in the locations of PMSE receivers in relation to PMSE calculations?*
- *Question T13: Do you have any comments on our proposed approach for the derivation of WSD-PMSE coupling gains for non-geolocated slaves in relation to PMSE calculations?*
- *Question T14: Do you have any comments on our proposed protection ratios in relation to PMSE calculations?*

CONSULTATION QUESTIONS TECHNICAL (5)

- *Question T15: Do you have any comments on our assessment that a margin for uncertainties in radio propagation is not necessary given the proposed parameters for derivation of coupling gains in relation to PMSE coexistence calculations?*
- *Question T16: Do you have any comments on our proposed WSD emission limits in relation to PMSE use in channel 38?*

Table 5.8 – WSD radiate power must not exceed (17 – *x*) dBm/(100 kHz) or (36 – *x*) dBm/(8 MHz) in relation to PMSE usage in channel 38.

x (dB)	Channel		
	38 ± 1	38 ± 2	38 ± 3
Class 1	0	0	0
Class 2	0	0	0
Class 3	5	0	0
Class 4	15	5	0
Class 5	25	15	5

- *Question T17: Do you have any comments on our proposal not to permit WSDs to operate in channel 60?*

CONSULTATION QUESTIONS TECHNICAL (6)

- *Question T18: Do you have any comments on our proposal that, if the unwanted emissions limit (over 230-470 MHz) in the draft ETSI standard (EN 301 598)* is tightened by 8 dB, there should be no further restrictions on the operation of WSDs in relation to services below the UHF TV band?*
- *Question T19: Do you have any comments on our proposal that, if unwanted emissions limit (over 230-470 MHz) in the draft ETSI standard (EN 301 598)* is not changed, there should be restrictions on the in-block powers of WSDs in channels 21 to 23?*

*** Draft ETSI EN 301 598, v 1.0.0 (2013-07), "White space devices (WSD); Wireless access systems operating in the 470 MHz to 790 MHz frequency band; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".**