EBU **TECHNICAL**

TV White Space Devices

Work progress in the CEPT

Webinar, 30 June 2011

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Programme

- Activities related to TV WSD in Europe
- Main questions:
  1. Why autonomous sensing is not (yet) a valid option for TV WSD?
  2. How the geolocation database is foreseen to be used for TV WSDs ?
  3. Why would hard power limits be required for TV WSDs ?
  4. What would be the operational and Regulatory conditions for WSDs ?
  5. How can PMSE be protected from TV WSDs?
  6. How to assess spectrum resources available for TV WSDs ?
- Conclusions

Structure of activities related to TV WSD in Europe

- ECC
- SE43 : Spectrum Egineering
- RA : Regulatory Affairs
- ETSI TC RRS: Reconfigurable Radio Systems
- EU funded projects

  E3 , PHYDYAS, SENDORA, SACRA, ARAGORN, FARAMIR, SAPHYRE, QoSMOS, QUASAR, CoGEU, COST-TERRA, ...

Why autonomous sensing is not (yet) a valid option for a TV WSD?

- The theoretical calculation of sensing thresholds (selected scenarios)

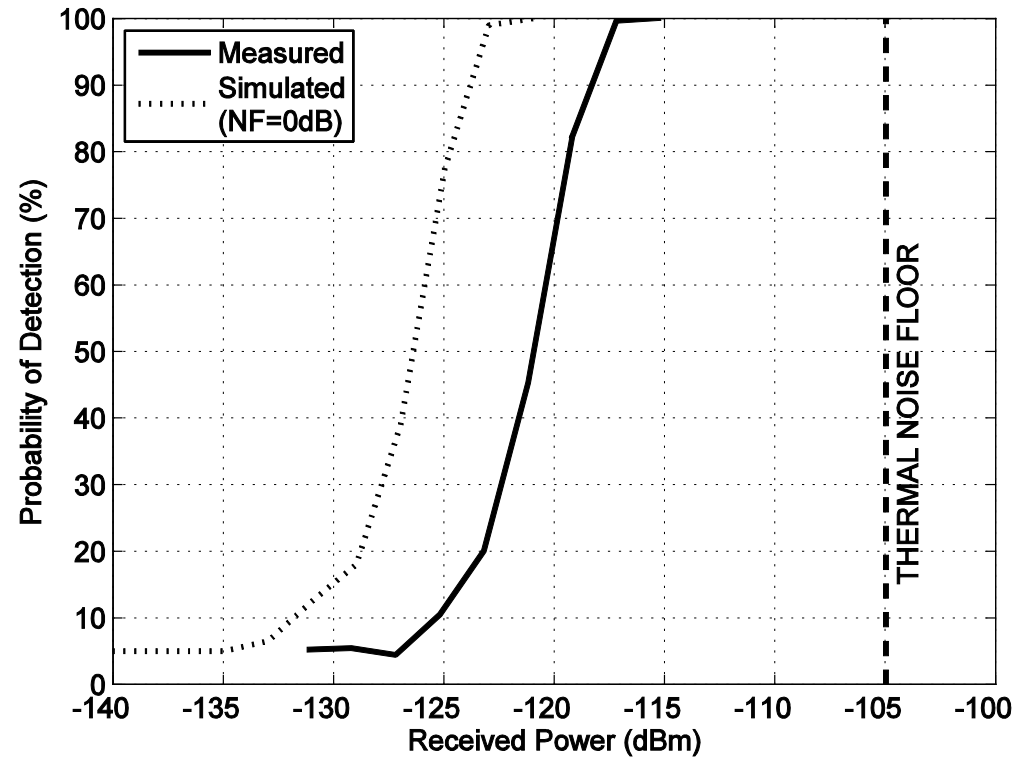
DTT deployment	**DTT fixed outdoor, at SubUrban area**	
Percentage location in the target detection area:	**95%**	
DTT receiver antenna height	**@10m**	
WSD deployment	**Mobile indoor @1.5m**	
$E_{med,plan}$	56.21	dBµV/m
$L_{HDTT - HWSD}$	17.01	dB
E_{med}	39.20	dBµV/m
$\sigma_{1,5m}$	5.50	dB
BPL	8.00	dB
σ_{BPL}	5.50	dB
σ_{indoor}	3.50	dB
Sensing reliability	99.99%	%
μ_{sense}	3.72	dB
$\mu_{sense}\sqrt{(\sigma^2_{1.5m}+ \sigma^2_{BPL}+ \sigma^2_{indoor})}$	31.72	dB
f_{sense}	650.00	MHz
G_{sense}	0.00	dBi
L_{pol}	3.00	dB
Lbody_loss	3.00	dB
E_{sense}	-0.52	dBµV/m
$P_{sense\_1.5m}$	-140.0	dBm

DTT	**DTT fixed outdoor, planned for SubUrban area**	
Percentage location in the target detection area:	**95%**	
DTT receiver antenna height	**@10 m**	
WSD deployment	**Fixed Outdoor @30m**	
$E_{med,plan}$	56.21	dBµV/m
$L_{HDTT - HWSD}$	-9.84	dB
E_{med}	66.05	dBµV/m
Sensing reliability	99.99%	%
$\sigma_{1,5m}$	5.50	dB
μ_{sense}	3.72	dB
$\mu_{sense}.\sigma_{1,5m}$	20.46	dB
f_{sense}	650.00	MHz
G_{sense} (Note 1)	0.00	dBi
L_{pol} (Note 2)	3.00	dB
L_{body_loss}	0.00	dB
E_{sense}	45.59	dBµV/m
$P_{sense\_1,5m}$	-90.86	dBm

Why autonomous sensing is not (yet) a valid option for a TV WSD?

- Outcome of recent practical studies (SE43-2 working document)

DVB-T transmitters	Espoo	Tallinn
Latitude:	60.1778	59.4713
Lognitude:	24.6403	24.8875
Mast heigth:	313 m	272 m
Transmission power:	47 dBm	42 dBm
Occupied channels	32, 35, 44, 46, 53	45, 59, 64



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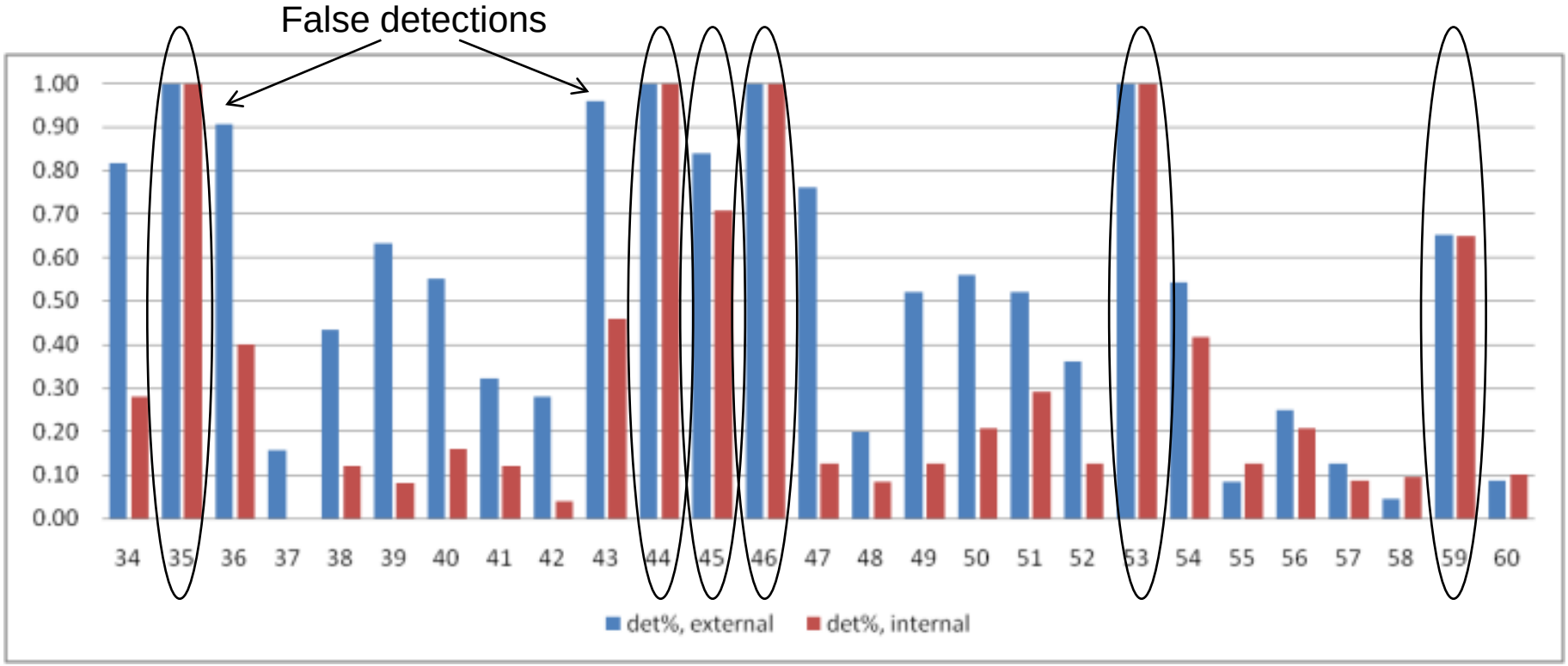
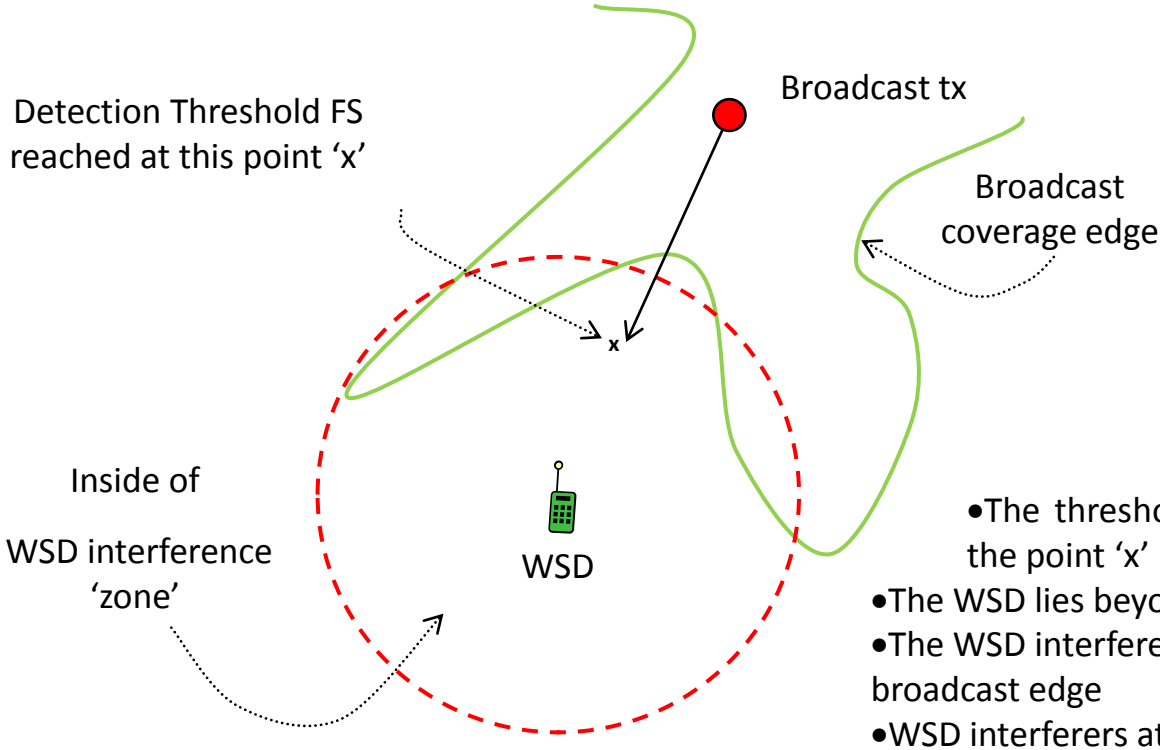


Figure 15. Measured probability of DVB detection, number of detections is 26 per channel, average distance to Espoo transmitter 9km and 78 km to Tallinn transmitter.

Why autonomous sensing is not (yet) a valid option for a TV WSD?

- The impossible autonomous assessment of distance to nearby co-channel coverage edge



- The threshold field strength level is reached at the point 'x'
- The WSD lies beyond the point 'x'
- The WSD interference zone still intersects the broadcast edge
- WSD interferers at points in the intersection of the broadcast coverage area and the WSD interference zone

Why autonomous sensing is not (yet) a valid option for a TV WSD?

- **The broadcasters' point of view**
  1. Sensing alone is not reliable enough to guaranty protection of TV reception in all circumstances;
  2. Sensing could be complementary to Geolocation with certain conditions;
- **Work item in SE43-2**

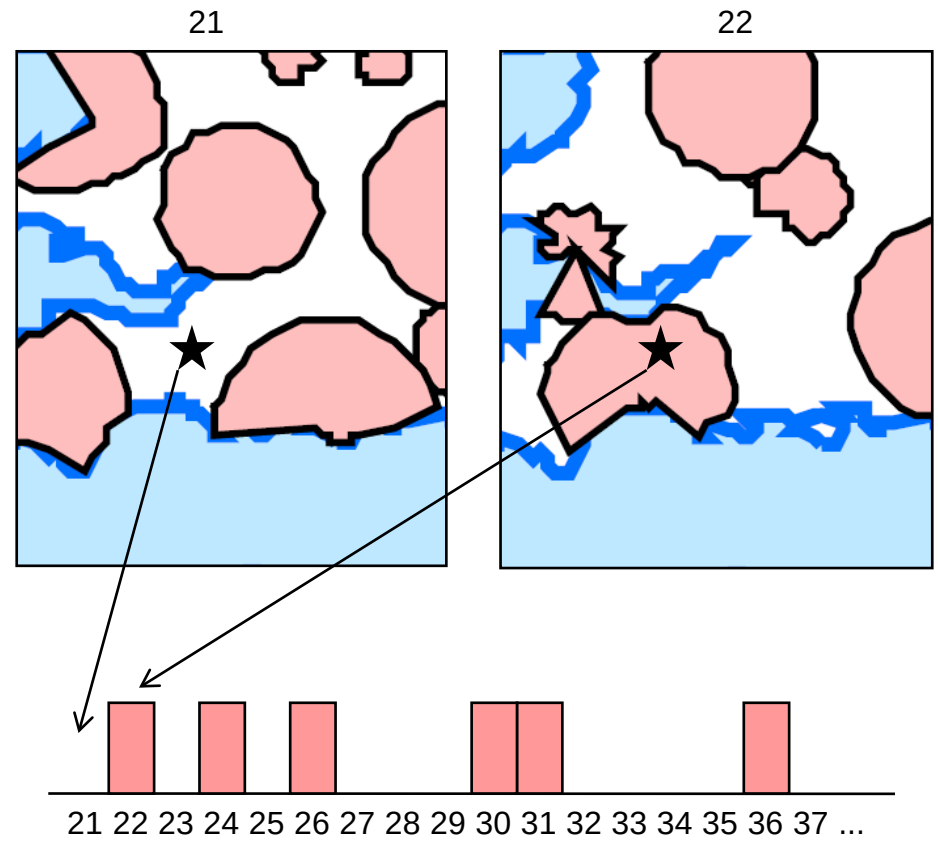
  Feasibility of a reliable autonomous operation of WSDs using sensing should be further addressed taking into account the possibilities offered by collaborative sensing techniques and experience that may be gained from sensing field test.

How the geolocation database is foreseen to be used for TV WSDs ?

1. Identification of available channels:

   Location of the WSD + coverage data of all transmitters using a given channel

   → channel is available or not at the WSD location

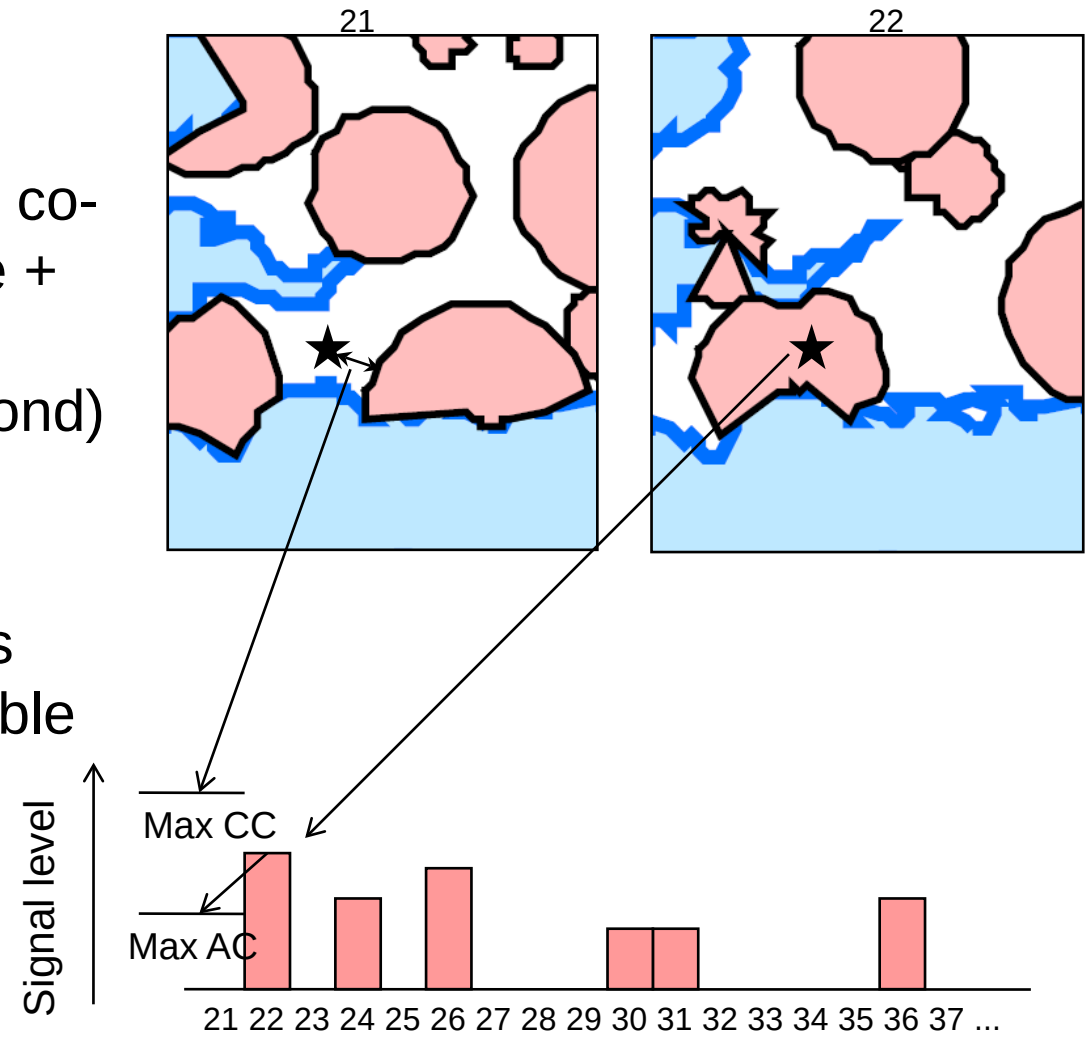


How the geolocation database is foreseen to be used for TV WSDs ?

2. Adjustment of power levels:

   Distance to the nearest co-channel coverage edge + levels of the adjacent channels (first and beyond) at the WSD location

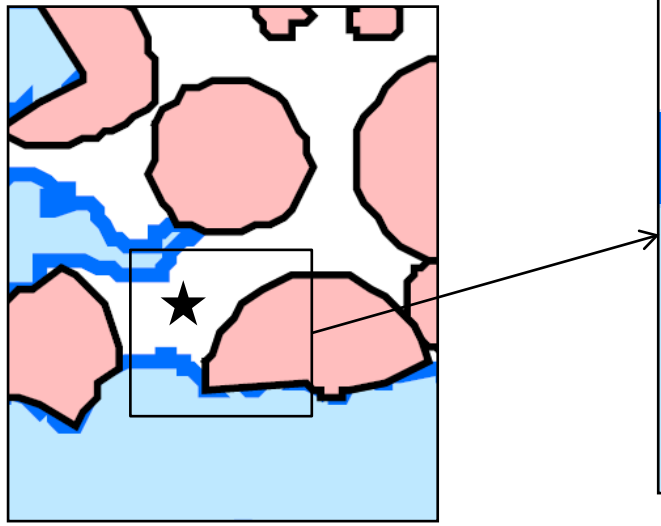
   → maximum transmit power of the WSD at its location for each available channel

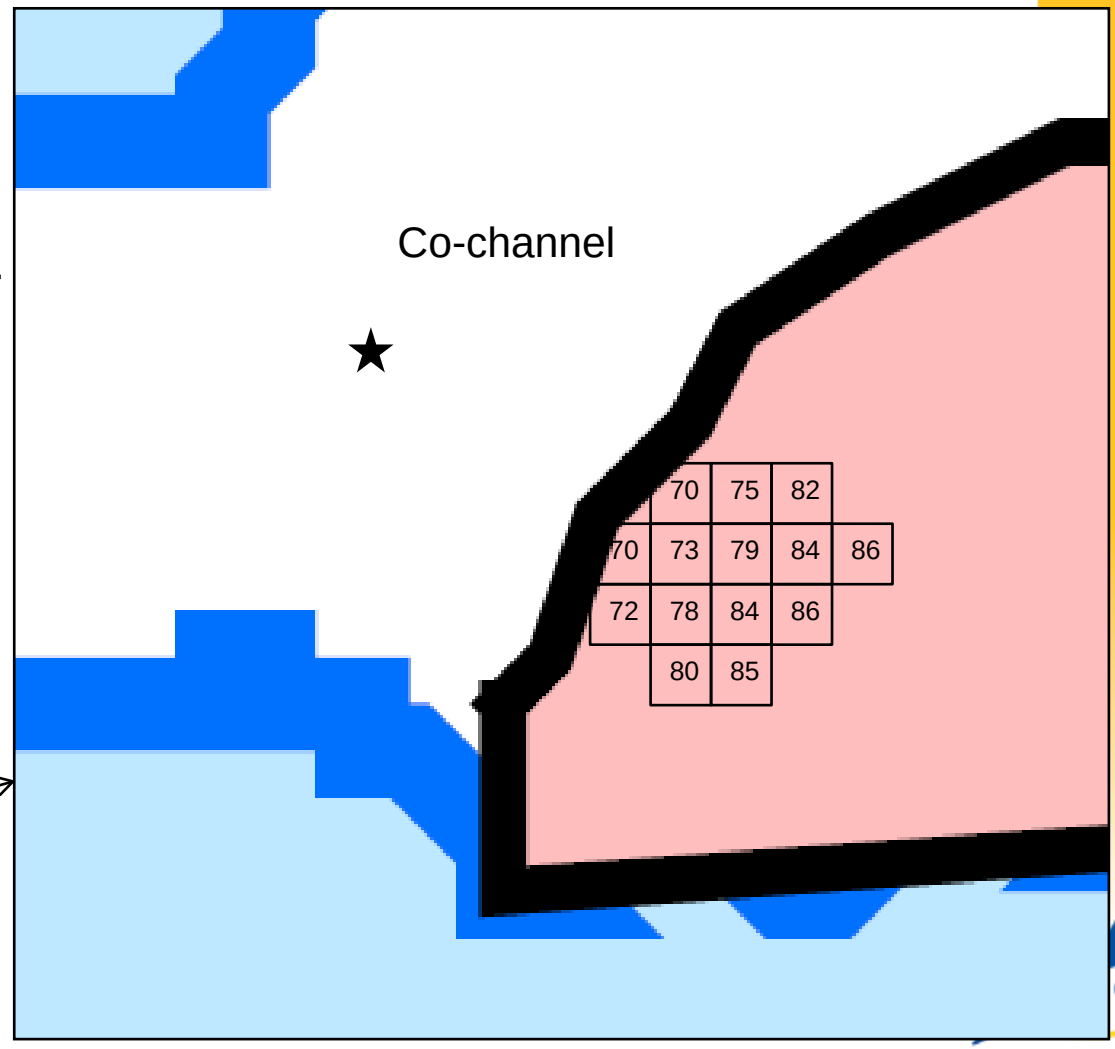


How the geolocation database is foreseen to be used for TV WSDs ?

- Principle of calculation

  The GDB contains actual values of location percentage covered by DTT at each pixel of the coverage area for each channel

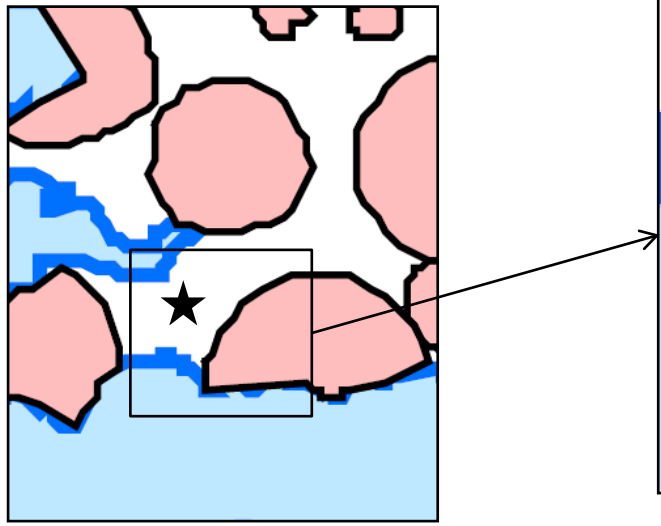


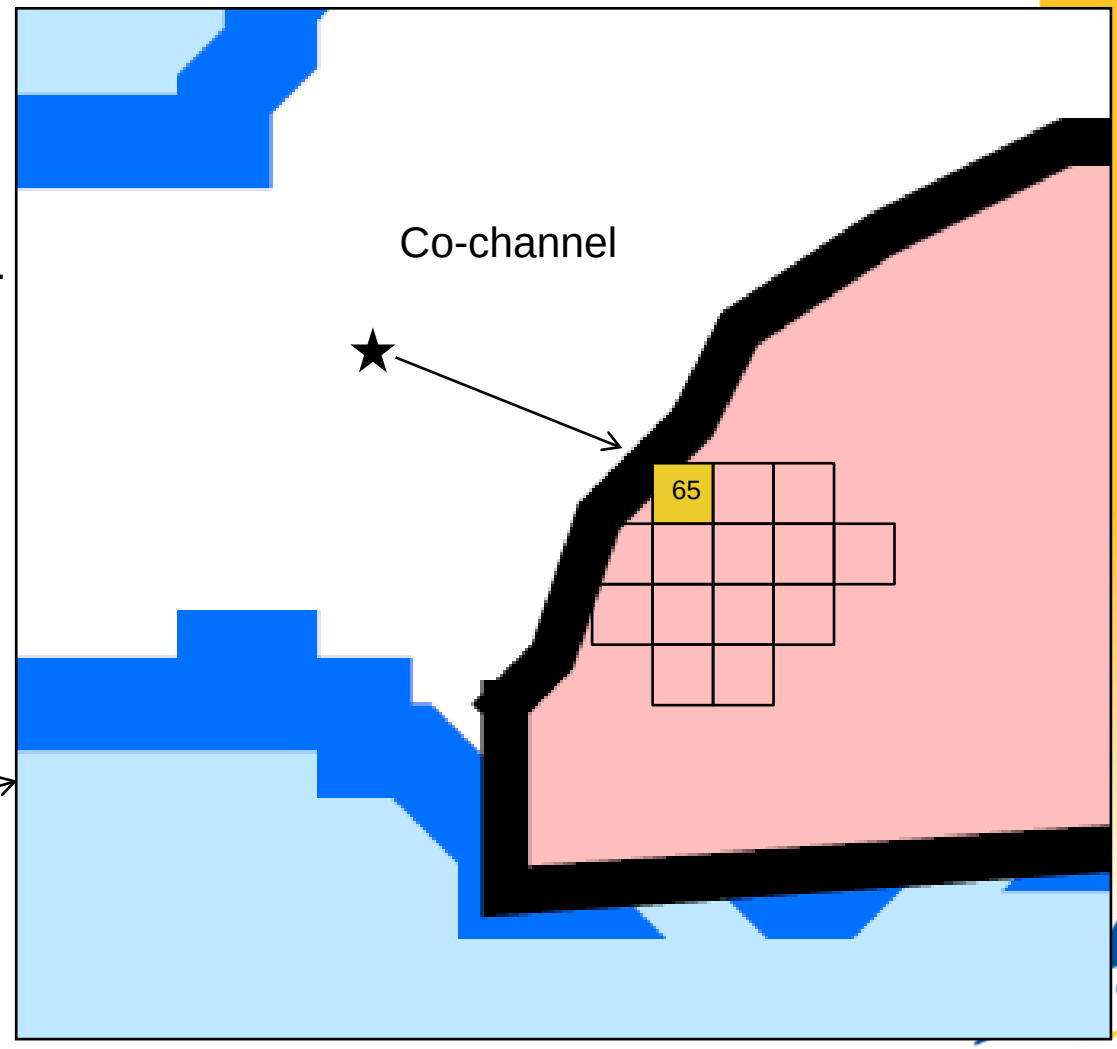


How the geolocation database is foreseen to be used for TV WSDs ?

- Principle of calculation

  The GDB calculates the final values of location percentage covered by DTT at the most affected pixels of the coverage area for each considered channel





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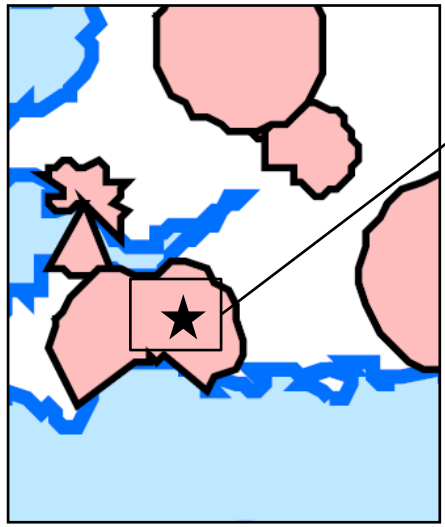

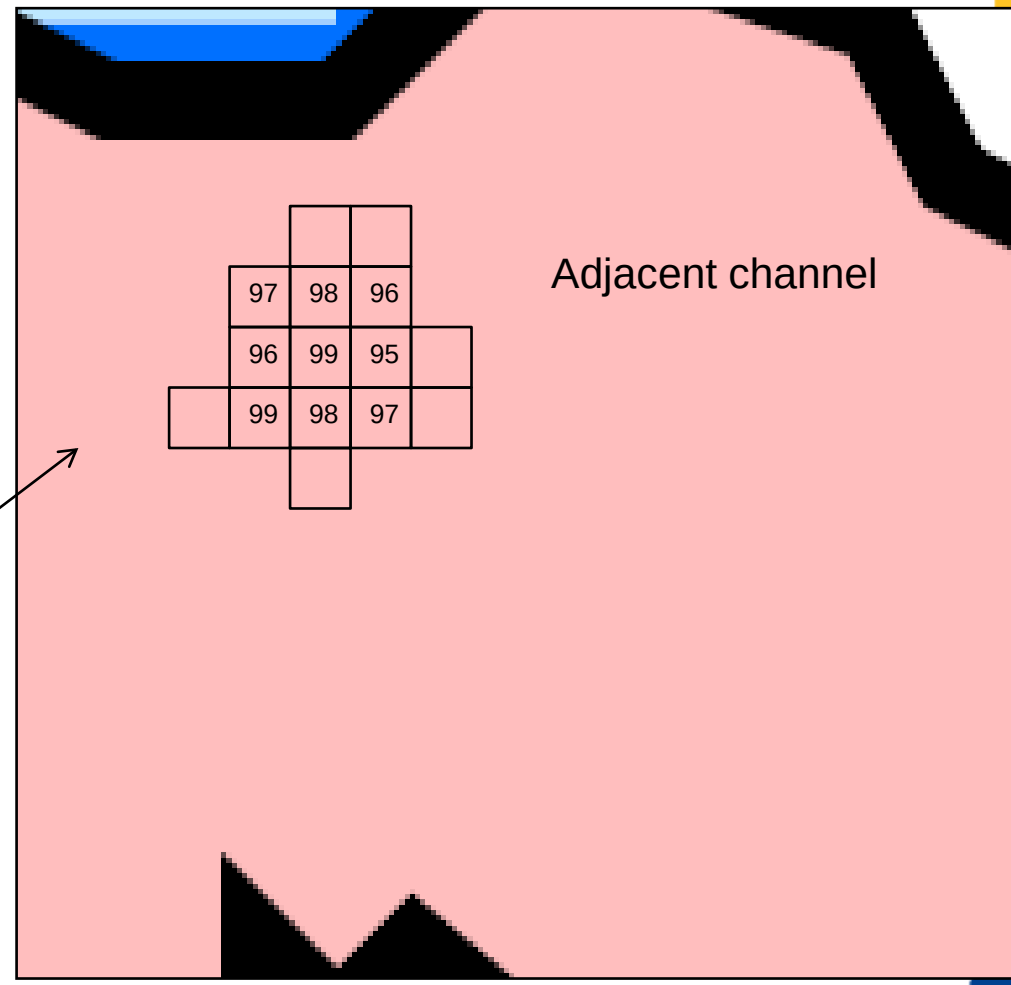

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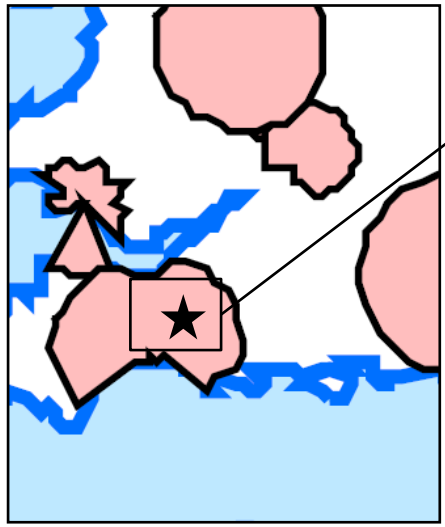
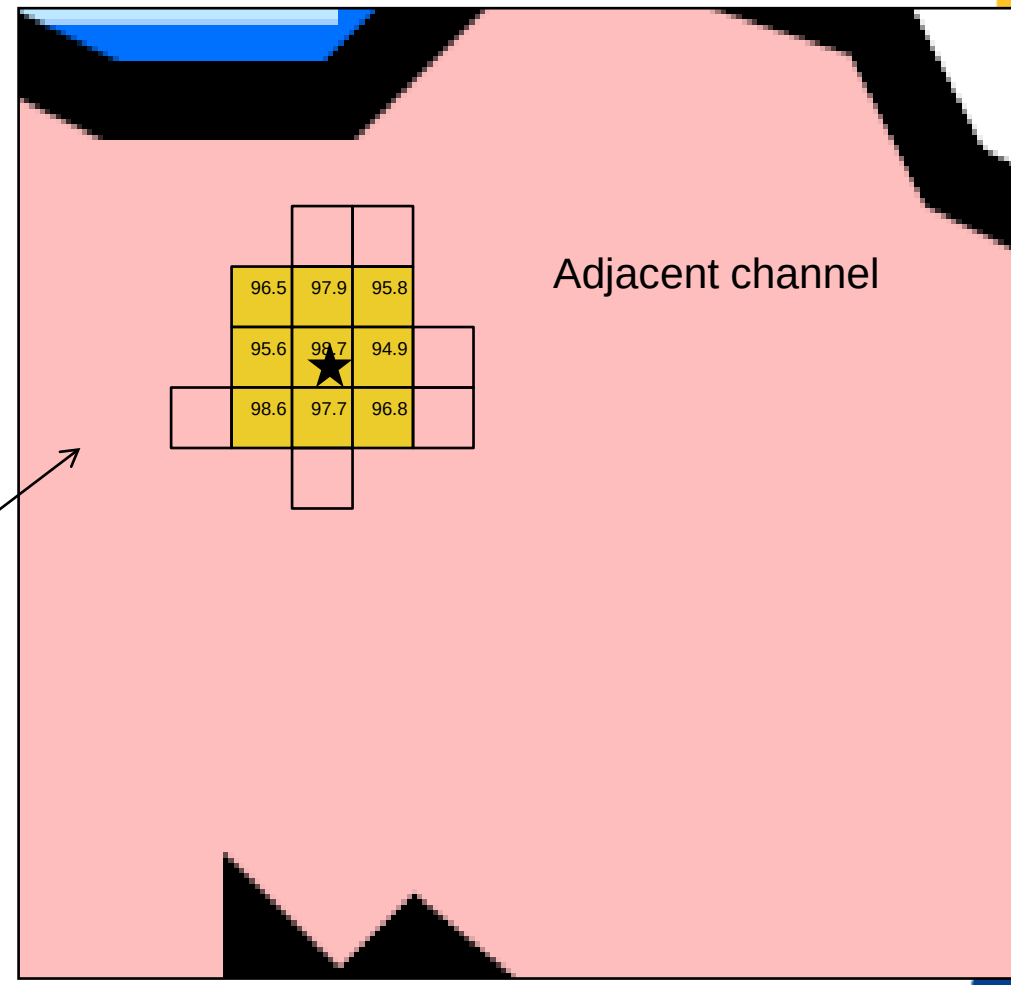




How the geolocation database is foreseen to be used for TV WSDs ?

- Method of calculation

  The GDB calculates the WSD maximum transmit power based on:

  - acceptable degradation of the location percentage at the most affected pixels of DTT coverage;
  - Overloading thresholds of DTT receivers for the relevant geometric configurations;
  - Acceptable increase in the noise power for receivers of services in the adjacent bands for the relevant geometric configurations (I/N threshold).

How the geolocation database is foreseen to be used for TV WSDs ?

- List of parameters that influence the final figure of WSD maximum transmit power:
  1. Acceptable degradation of the location percentage of the DTT coverage
  2. Protection ratios between wanted DTT signals and interfering WSD signals and overloading thresholds of the DTT receivers
  3. Acceptable increase in the noise power for receivers of services using adjacent bands
  4. DTT reception mode (fixed roof top, portable/mobile)
  5. Type of WSD (fixed outdoor, portable/mobile indoor)
  6. Geometric configuration between each type of WSD and the DTT receiving antenna for each reception mode (separation distance, antenna height, antenna polarisation and directivity)
  7. Number of possible simultaneous interfering WSD
  8. Additional propagation related factors (Body loss, Wall loss)

How the geolocation database is foreseen to be used for TV WSDs ?

- The broadcasters' point of view
  1. Need to define common agreed set of parameters to ensure similar level of protection for broadcasting in Europe (EBU proposals made to SE43-2);
  2. Need to define types of WSD and Upper limits of the transmit power for each type;
  3. Need to give guidance on the required accuracy of the information in the Geolocation data base to avoid errors in channel identification and calculation of the WSD maximum transmit power

How the geolocation database is foreseen to be used for TV WSDs ?

- List of parameters proposed by EBU:
  1. Acceptable degradation of the location percentage of the DTT coverage: 0.1% combined with threshold on I/N set to -3 dB, whichever is reached first;
  2. Protection ratios between wanted DTT signals and interfering WSD signals and overloading thresholds of the DTT receivers: First assumptions are based on LTE figures;
  3. DTT reception mode: fixed roof top, portable/mobile according to the national planning models
  4. Type of WSD: Two types are proposed by EBU: fixed outdoor, portable/mobile indoor or outdoor
  5. Geometric configuration between each type of WSD and the DTT receiving antenna for each reception mode (separation distance, antenna height, antenna polarisation and directivity):
     WSD Fixed into DTT fixed or WSD Portable/mobile into DTT fixed : 20-22 m,
     WSD Portable/mobile into DTT Portable /mobile: 2 m.
  6. Number of possible simultaneous interfering WSD: 3 devices for the adjacent channel case, figure still to be defined for the co-channel case;
  7. Additional propagation related factors (Body loss, Wall loss): No Body loss or wall loss for the fixed outdoor WSD, only Body loss for the mobile outdoor WSD, no Body loss or wall loss for the portable indoor WSD

How the geolocation database is foreseen to be used for TV WSDs ?

With this set of assumptions, example of maximum EIRP for WSD can be calculated (EBU contribution to SE43-2):

a) For the protection of DTT fixed reception, a fixed WSD (respectively portable outdoor WSD) using a channel with a frequency offset corresponding to a protection ratio of -50 dB (probably the third adjacent channel and beyond), can be operated with an EIRP in the range of -4 to +13 dBm (respectively -7 to +11 dBm) depending on its location within the DTT coverage area;

b) For the protection of DTT portable outdoor reception, a portable WSD using a channel with a frequency offset corresponding to a protection ratio of -50 dB (probably the third adjacent channel and beyond), can be operated with an EIRP in the range of -23 to -4 dBm depending on its location within the DTT coverage area.

How the geolocation database is foreseen to be used for TV WSDs ?

- Progress as per ECCRep159
  1. The calculation method has been defined;
  2. Examples of calculation based on various sets of assumptions were produced;
  3. No common set of parameters was defined.

- Task set for SE43-2:

  "*Identification of a common set of the parameters defined in the methodology described in draft ECC Report 159 to calculate location specific WSD power levels*"

Why would hard power limits be required for TV WSDs?

- The two main use cases of TV WSDs:
  1. Small, low power devices for portable indoor/outdoor usage. One device could be acting as master and several others as slave devices (similar to Wifi routers and associated user equipments)
  2. Higher power devices for fixed outdoor usage, possibly acting as a master, associated with small devices acting as slave devices (similar to base stations with associated user equipments)

Why would hard power limits be required for TV WSDs?

- The broadcasters' point of view: Hard power limits are required for TV WSDs, for several reasons:
  1. Technical reasons:
     a) overloading of DTT receivers
     b) co-channel interference with cable
     c) Spectrum availability for TV WSDs
  2. Regulatory arguments: Above certain power level, regulatory constraints change: for example, unlicensed regime and secondary status (no protection no interference) may be feasible for low power devices, but not for base stations with large coverage.

Why would hard power limits be required for TV WSDs?

- The progress as per ECC Rep159:

  No classification of WSD types and maximum e.i.r.p were defined so far in CEPT.

- Action item for SE43-2:

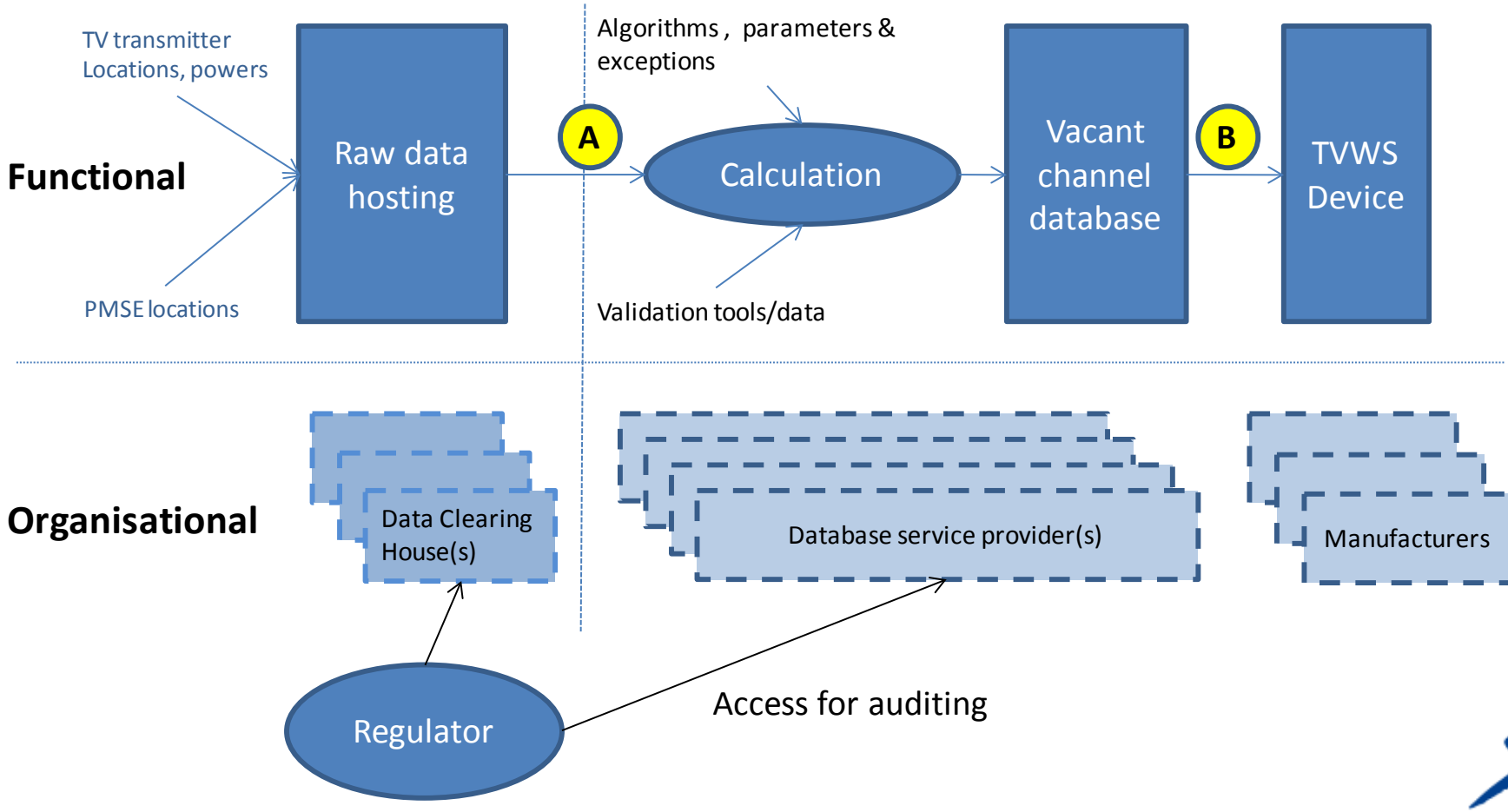
  (To study) "*The possibility to set up fixed maximum permitted e.i.r.p. limits for WSDs taking into account indications from the industry on the foreseen operational ranges of WSDs and their possible classification.*"

What would be the operational and Regulatory conditions for TV WSDs ?

- Options for database management (all options can be applied for one country or for whole of Europe)
  a) Single open database: Open to all users;
  b) Multiple open databases: Open to all users, offering improved availability and possible value-added information
  c) Proprietary closed databases: limited to specific users (WSD manufacturers for example)

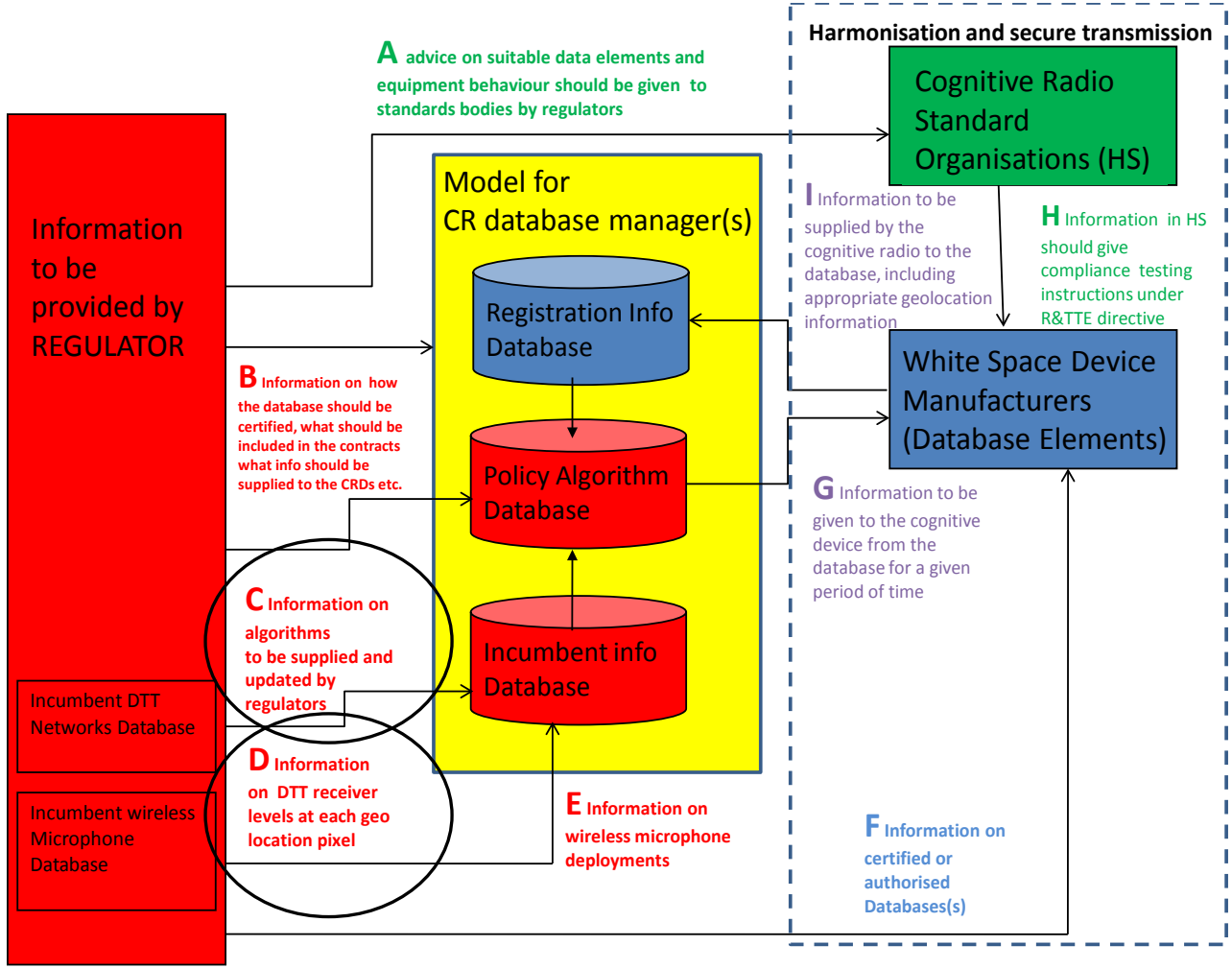
What would be the operational and Regulatory conditions for TV WSDs ?

- ‘Clearinghouse’ model (source ECC Rep159):



What would be the operational and Regulatory conditions for TV WSDs ?

- Possible roles and information flow (source RA(11)50 annex 1):



What would be the operational and Regulatory conditions for TV WSDs ?

- **Important for broadcasters**:
  1. Specifications of Geolocation database structure and interfaces: Common European specifications facilitate development of pan European databases;
  2. Specifications of requirements for WSDs, including compliance testing instructions: Common European specifications facilitate movements of WSDs in Europe;
  3. Specifications of required information on DTT networks, on DTT receiving levels and on translation algorithms in the Geolocation database: Common European specifications permit harmonised way of insuring protection to DTT services thoughout Europe.

What would be the operational and Regulatory conditions for TV WSDs ?

- **Also very important for broadcasters**:

  The possible future regulatory status of TV WSDs:

  “the current CEPT view is that any white space device should be used on a non protected non interfering basis”

  (cf. CEPT report 24, 27 June 2008)

What would be the operational and Regulatory conditions for TV WSDs ?

- **The progress in CEPT**:

  - ECC Rep159: Basic considerations of operational and technical requirements;

  - Ongoing development in ECC/WGRA/RA_WS_CR (correspondence group), see document RA(11)50 of 4 May 2011.

- **Action items for SE43-2 and RA_WS_CR**:

  The authors' understanding is that

  - SE43-2 will focus mainly on specifying interfaces, translation algorithms and data accuracy of the geolocation database;

  - RA_WS_CR will focus on Regulatory issues including setting up and management of the geolocation database.

How can PMSE be protected from TV WSDs?

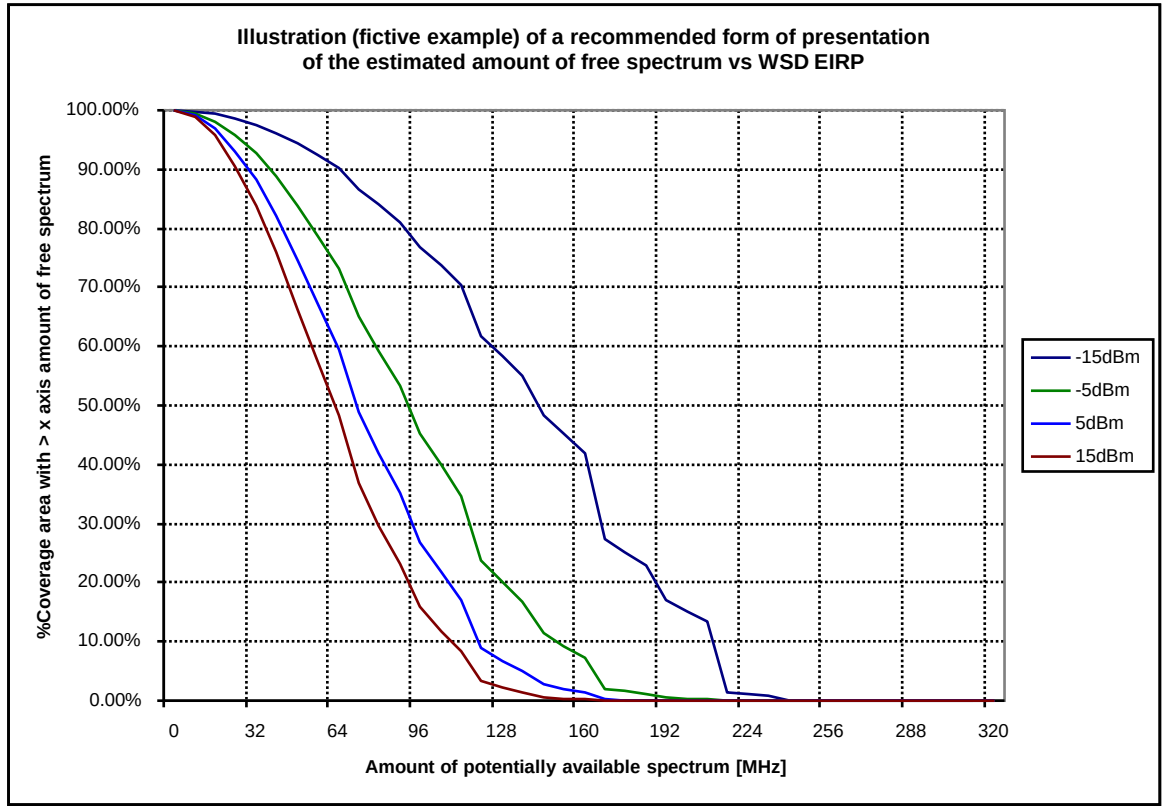
- **Conclusions of ECC Rep159**
  1. geo-location database appears to be the most satisfactory approach considered so far, however a number of practical questions still require resolution;
  2. Spectrum sensing remains a problematic approach for protecting PMSE systems from interference, which needs more development;
  3. The disable beacon concept is an approach which can help to overcome sensing issues;
  4. Identification by national administration of at least one (or more) safe harbor channel, not used by DTT and which would be reserved for PMSE use would be helpful for the protection of PMSE, in particular for casual or unplanned usage by PMSE which would not be registered (in the geolocation database)

How can PMSE be protected from TV WSDs?

- Several action items for SE43-2 on PMSE protection, including:
  - Characteristics of PMSE systems
  - Further investigation of propagation aspects to further explore sensing solutions
  - Viability of the Beacon's solution

How to assess spectrum resources available for WSDs ?

- Outcome of ECC Rep159:
  - Indications about the recommended form of presentation
  - Need to show Area and Population coverage
  - First examples of preliminary national studies



Conclusions

- Sensing alone is not (yet) a viable option for TV WSD;
- Sensing could be complementary to Geolocation;
- The method of calculation of maximum e.i.r.p for TV WSD with geolocation database is well defined;
- Attempt to define a common set of parameters for the calculation of maximum e.i.r.p;
- Possible definition of Types of WSDs with associated hard power limits;
- Definition of operational and regulatory conditions for Geolocation database is ongoing;
- Protection of PMSE is difficult, solutions still to be found
- Method for assessment of spectrum resources for TV WSDs is defined

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Thank you

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