COGEU

Cognitive radio systems for efficient sharing of TV white spaces in European Context

Policies to enable secondary spectrum trading of White Spaces and online spectrum broker demonstration

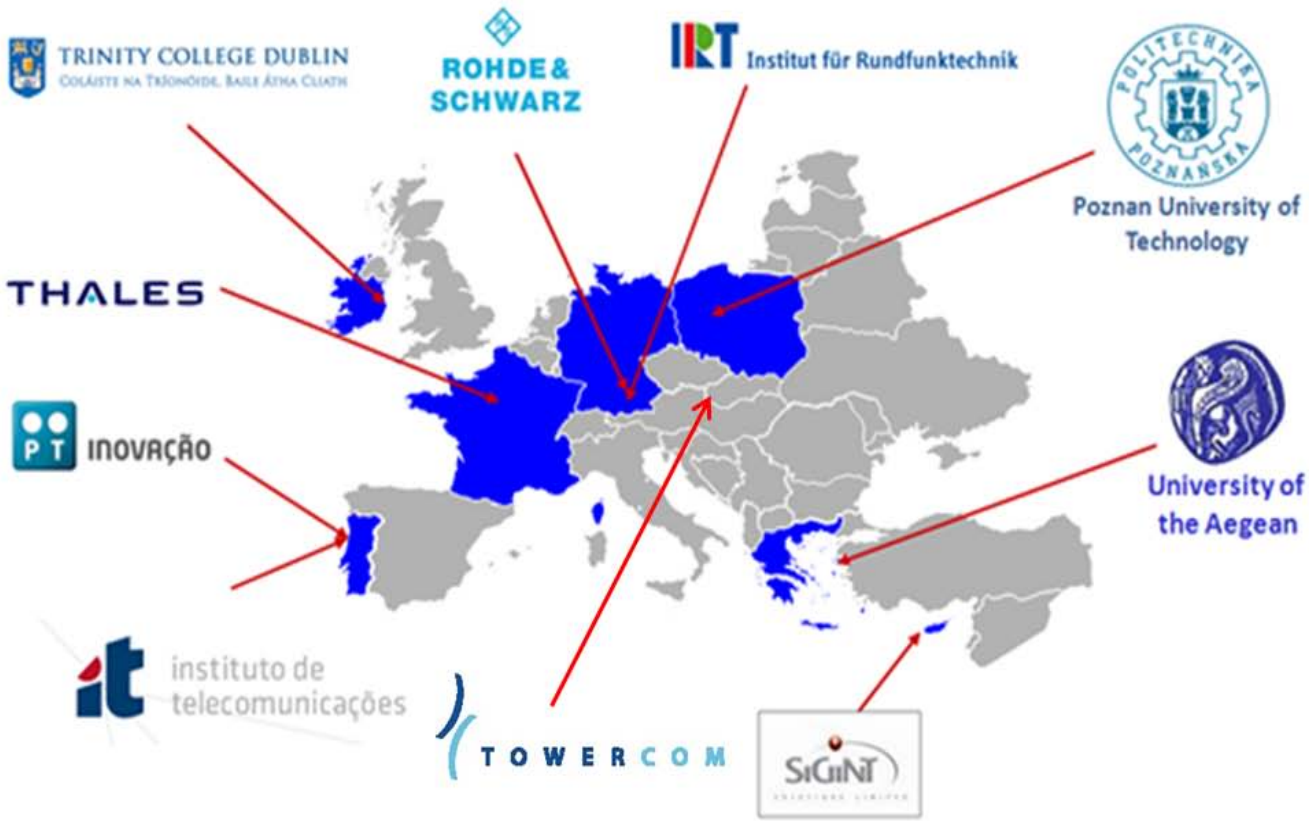
Paulo Marques – Instituto de Telecomunicações, Portugal

2007 - 2013

1. Overview and objectives
2. Business models
3. Enabling regulation
4. Enabling technologies
5. Database and broker demo

1. Overview and objectives

COGEU



RIM

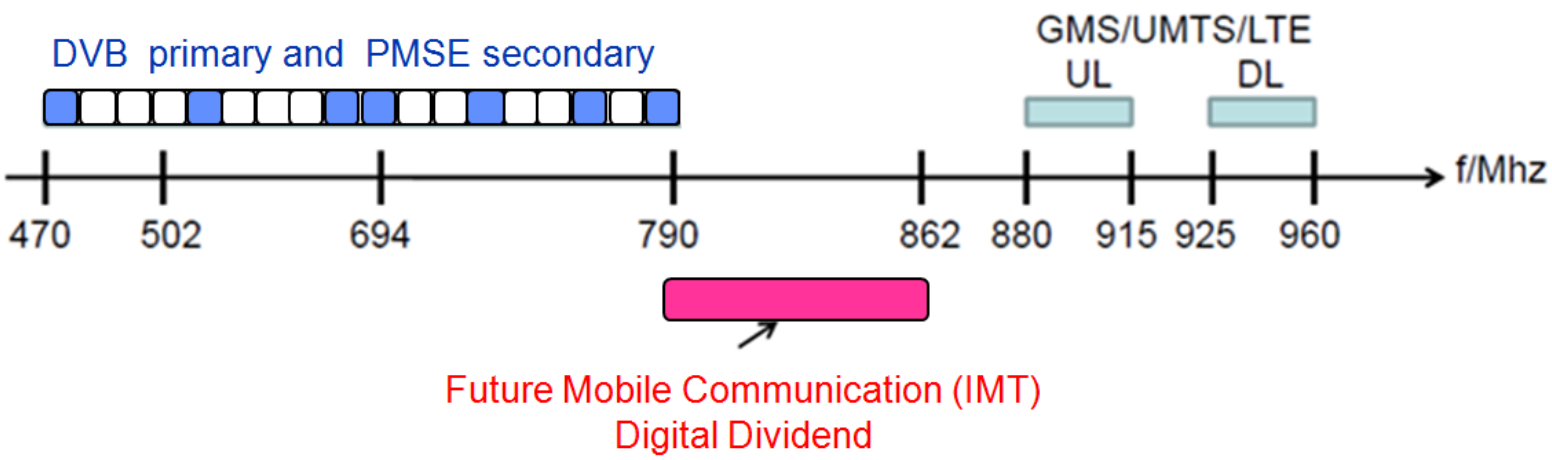
HUAWEI

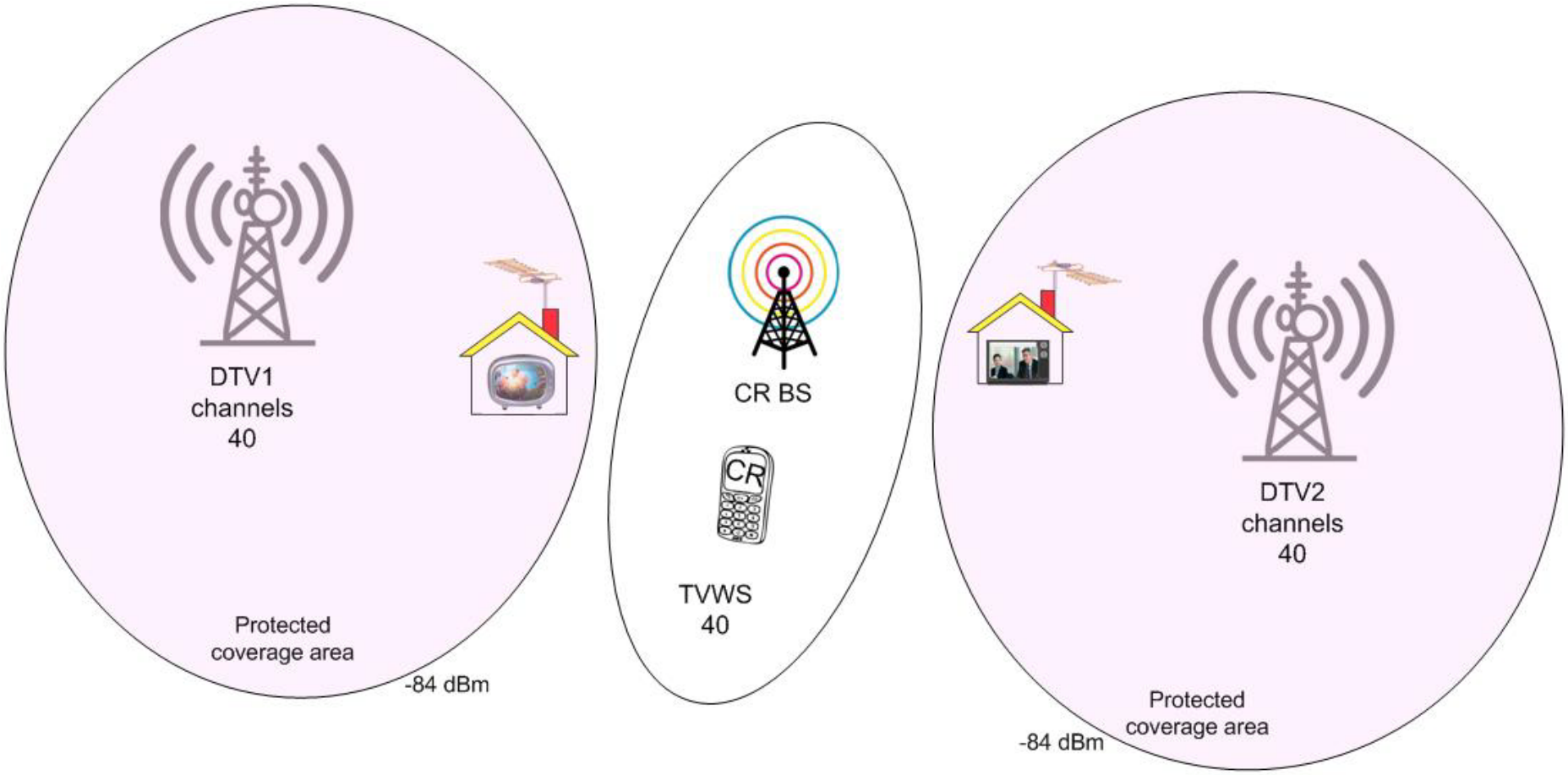
January 2010 – December 2012

2007 - 2013

- After the digital switch over, not all channels from 470 MHz to 790 MHz are occupied at each location. **This locally unused channels are called TV White Spaces (TVWS).**

- How to transform the TV White Spaces into social benefits and economic growth ?




DTV1
channels
40
Protected
coverage area
-84 dBm
CR BS
CR
TVWS
40
DTV2
channels
40
Protected
coverage area
-84 dBm

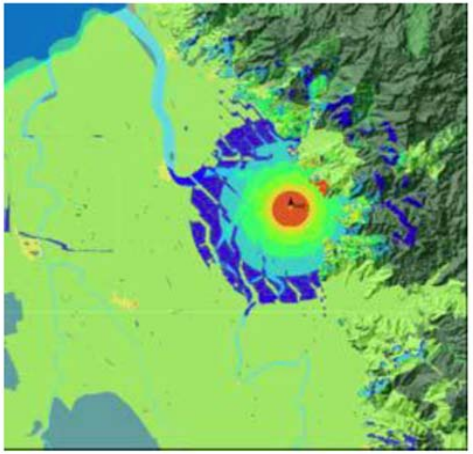
think
local

spectrum

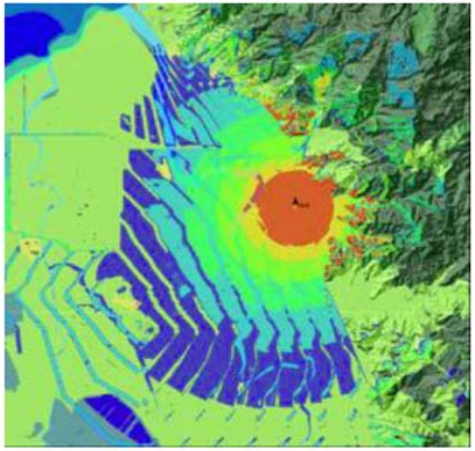
Why TVWS are so valuable ?

- TVWS are quite stable because terrestrial broadcasting is planned around relatively inflexible ' high power – high tower' distribution networks.

- Strong interest by Mobile Communication Network operators to lower frequencies, as network rollouts costs are dramatically lower.



2.6 GHz coverage



700 MHz coverage

- The main objective of the COGEU project is to design, implement and demonstrate enabling technologies to allow an **efficient use of TVWS in Europe**.

- Define new methodologies for TVWS equipment certification and compliance addressing **coexistence with the DVB-T European standard**.

- To investigate **innovative business models for TVWS exploitation** based on spectrum commons and **secondary market regimes**, to increase spectrum utilization enabling innovative wireless services.

NOTHING

HIGH-SPEED INTERNET

2. Business models

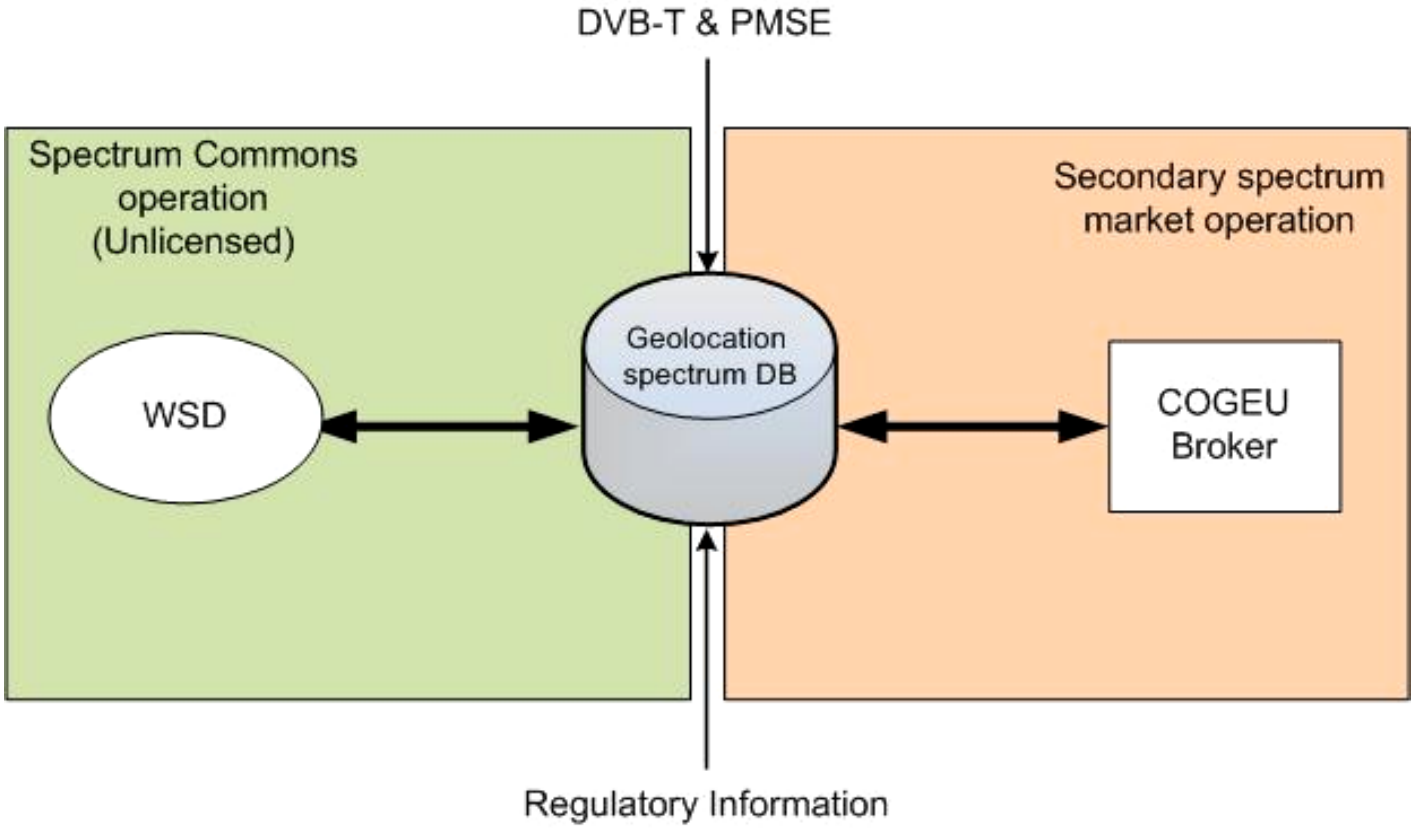
COGEU hybrid model

- Currently, only unlicensed access to TVWS is envisage - allowed by some regulators.

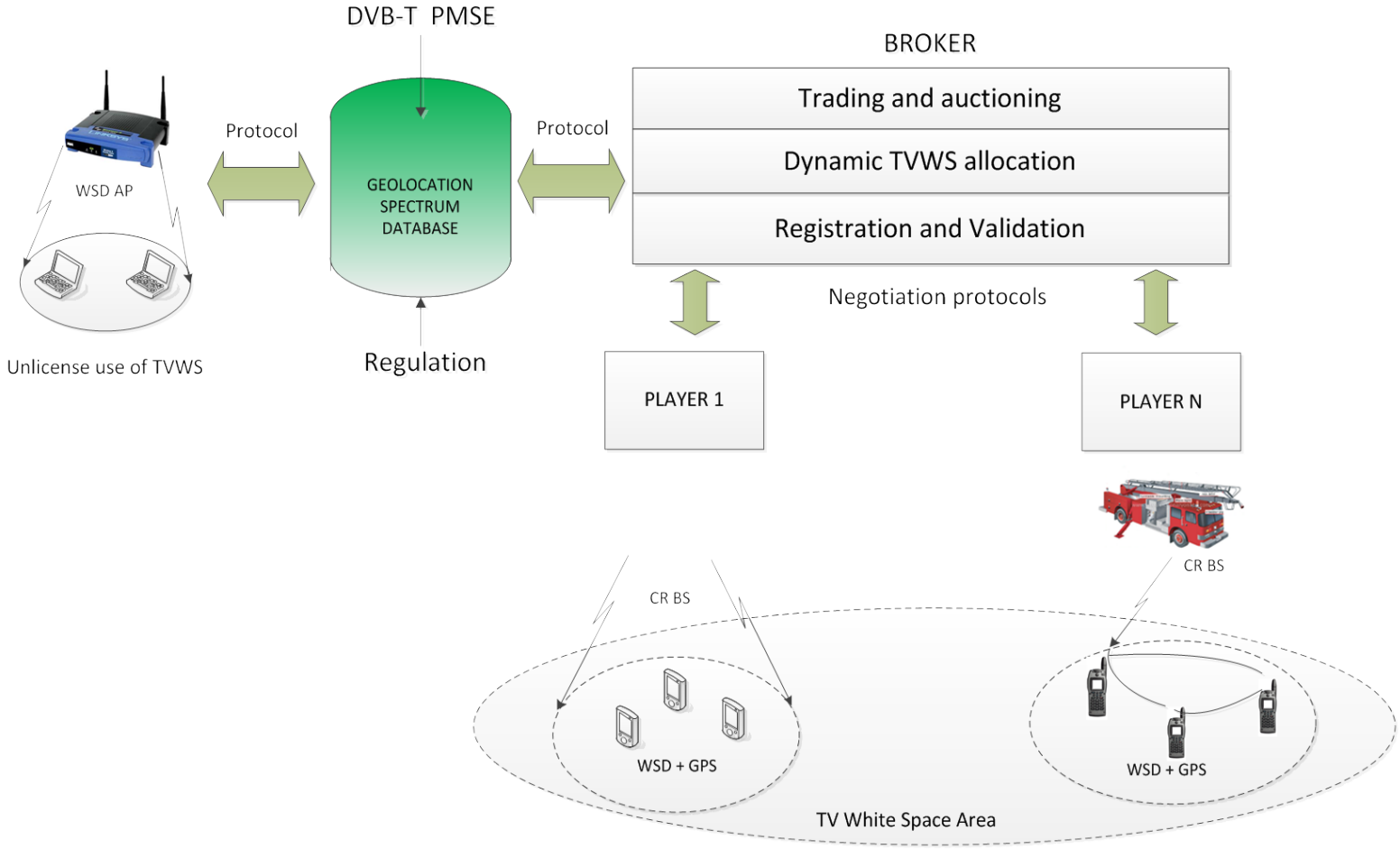
- In COGEU model, the regulatory bodies assign TVWS for unlicensed access in given areas (free). The remaining TVWS can be traded in a secondary spectrum market trough a **spectrum broker**.

- COGEU investigates an **extension of this regulatory regime** and proposes a secondary spectrum market of TVWS that can leverage the value of these underutilized bands.

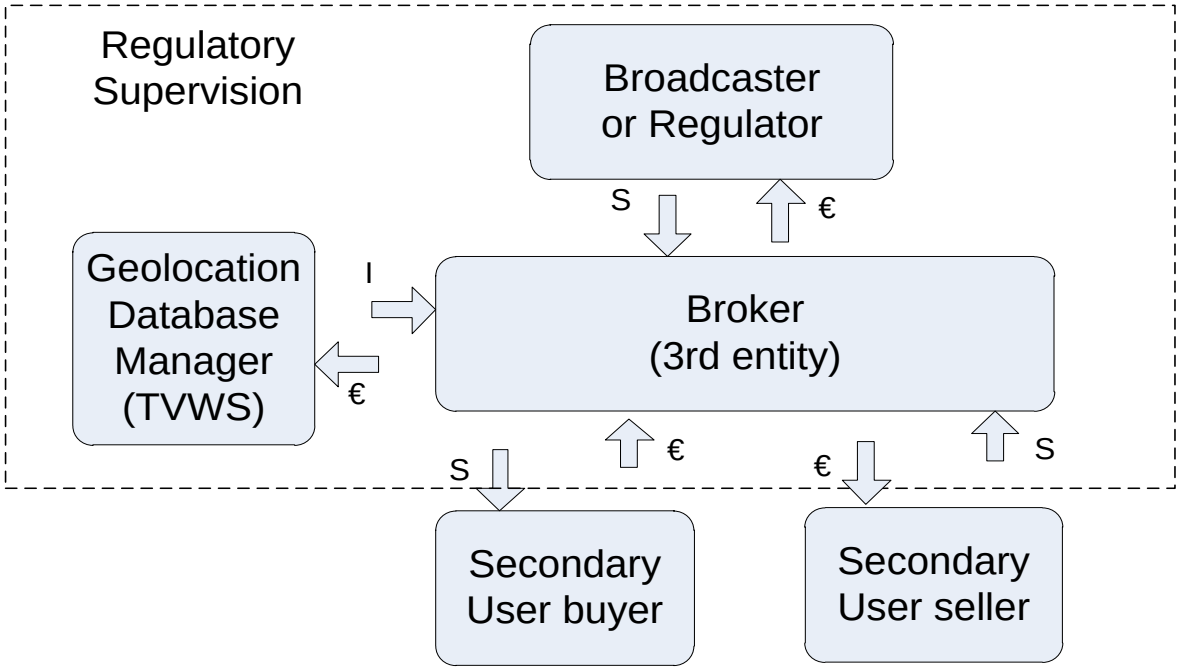
COGEU hybrid model



COGEU hybrid model



New business models – Broadcasters in the value chain

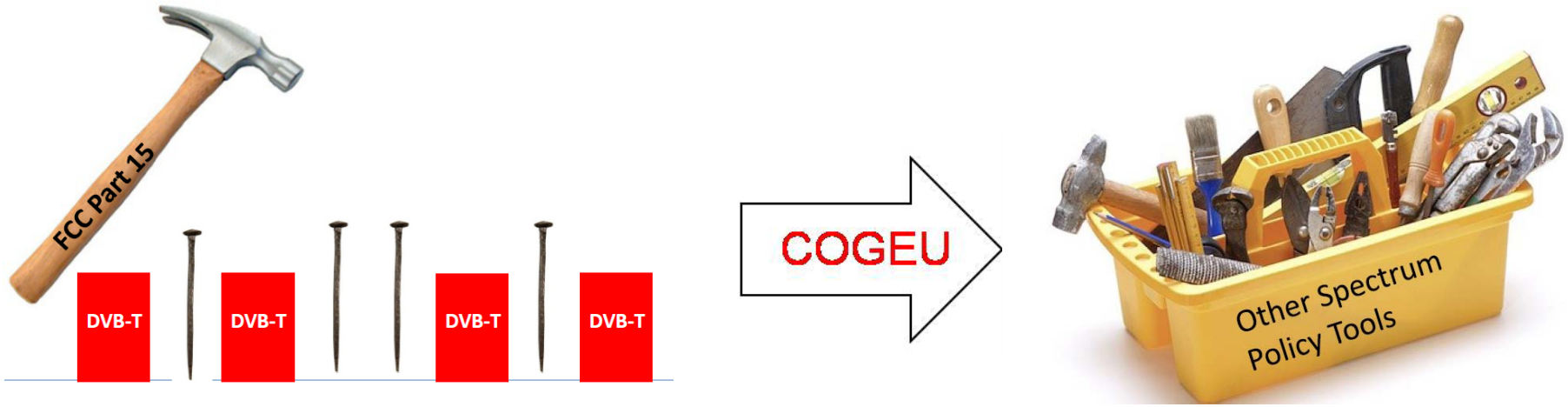


I : information S : TVWS spectrum

3. Enabling regulation

TV White Spaces policies to enable efficient spectrum sharing

- COGEU model proposes a secondary market of TVWS which is beyond current proposals from regulators: Unlicensed and Low power.
- COGEU uses 3 regulatory tools to create an ecosystem for TVWS secondary trading in Europe: Geographic interleaved awards, Band Managers and Simplified spectrum leasing.



Tim Forde, "A TV Whitespace Trading Ecosystem for Cognitive Radios", COGEU Workshop, 10 Nov. 2011, Munich

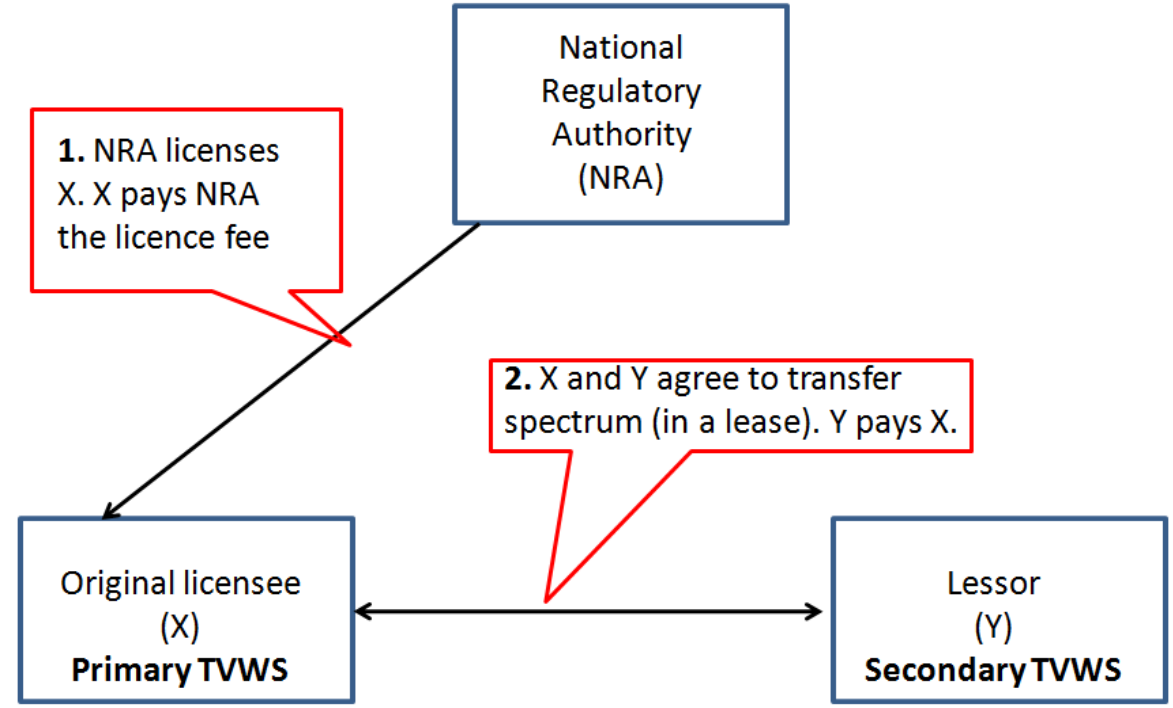
TV White Spaces policies to enable efficient spectrum sharing

- The basic premise of COGEU approach is that National Regulatory Authorities (NRAs) should license flexible geographic interleaved awards to Primary TVWS users/licensees, i.e. the holder of a geographic interleaved award (or TVWS license).

- This Primary TVWS licensee could operate as a Band Manager of its own spectrum (COGEU broker). It would have the right, and associated responsibilities, to lease its spectrum to third-parties (secondary users) without recourse to the NRA allowing an automatic spectrum trading process.

TV White Spaces policies to enable efficient spectrum sharing

- Simplified spectrum Leasing which detaches the NRA (National Regulatory Authority) from involvement in the execution of every single trade should be brought forward.



Band Manager – COGEU broker

TV White Spaces policies to enable efficient spectrum sharing

- COGEU recommends that the regulators will not supply the sensitive data concerning broadcast transmitter parameters. Therefore, the regulator would convert the incumbent's data (confidential raw data) into a list of allowed frequencies and associated transmit powers by performing TVWS calculations.
  - Involvement of regulators in the population of the database limits the over-conservative calculation or over-estimation of TVWS.
  - As the choice of parameters heavily influences the results (maximum transmit power and amount of TVWS) regulators and policy makers have to fix parameters to have a solid basis for calculations.

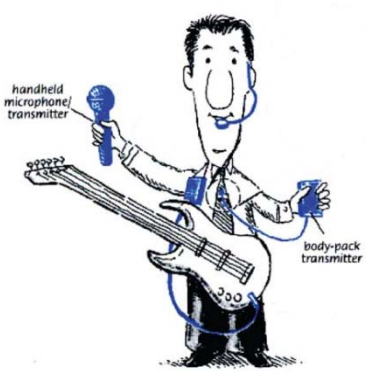
- For the geo-location database, it will be desirable to have European standardised protocols/languages to access the database and format of data within it.

- Cross-border issues have to be considered in the specification of the database.

COGEU policies for PMSE protection

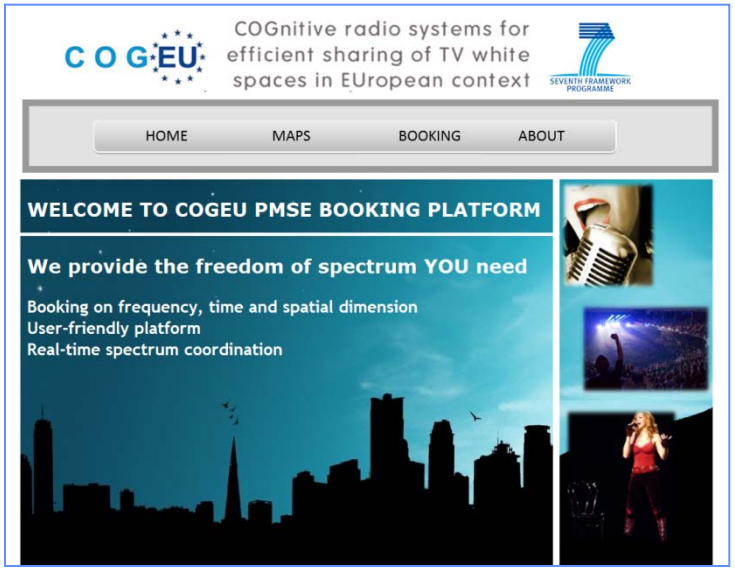
- COGEU recommends that Europe implements "safe harbor" channels for the exclusive PMSE usage, i.e., number of TVWS channels for reserved PMSE usage only in which no TVWS devices would be permitted. Within this scenario sensing is not necessary because primary users (PMSE, DVB-T) are protected by the geo-location database.

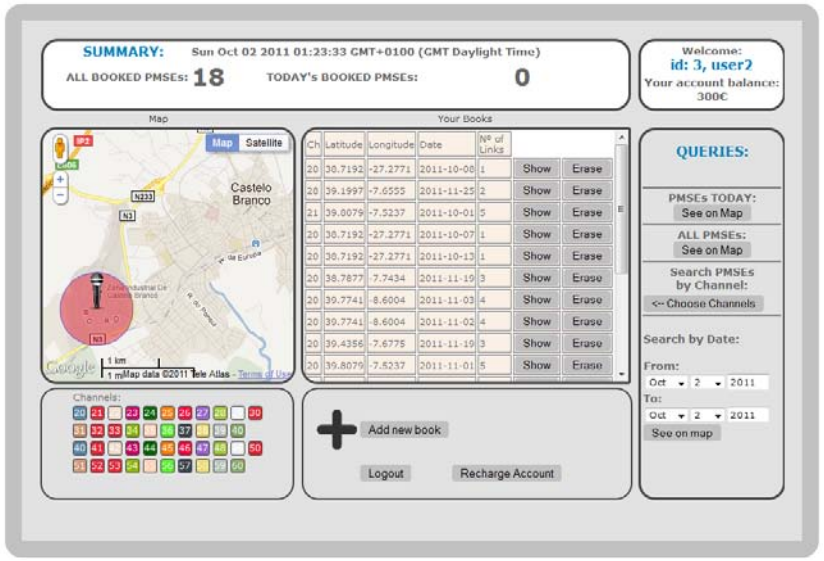
- The "safe harbor" bands are flexible and it may change from country to country. The reallocation to "safe harbor" channels of PMSEs will allow a secondary market of clean TVWS providing services with high QoS requirements.



COGEU policies for PMSE protection

- Professional PMSE applications which location\time can be predicted in advance can be protected by a PMSE booking system as demonstrated by COGEU (available online).





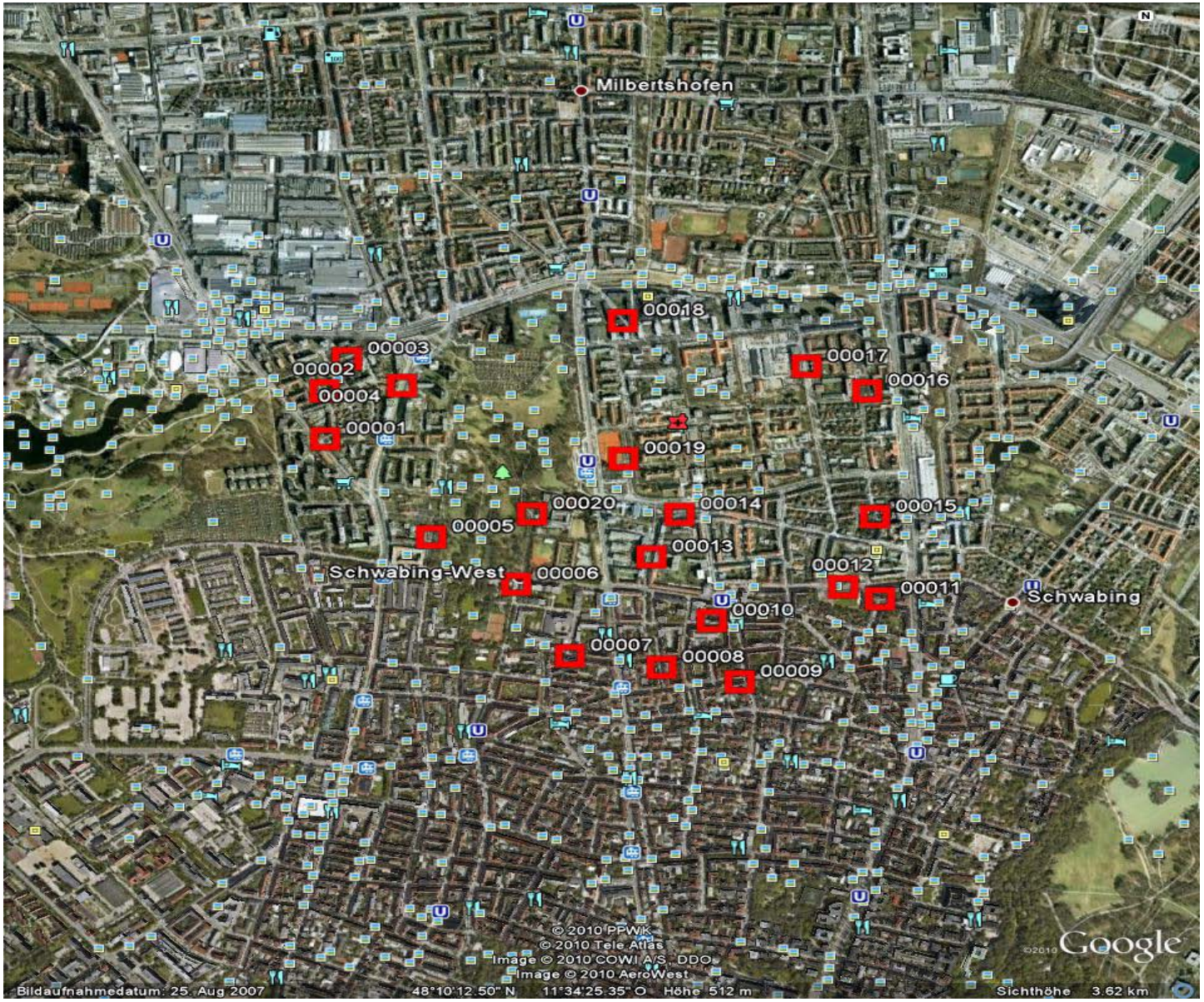
COGEU polices for TV White Spaces certification

- All devices and entities that are to use the geo-location database need to be accredited by an authority, ensuring that, protocols and restraints/constraints are implemented and are available on any WSD device, to complying with the database instructions and limitations.

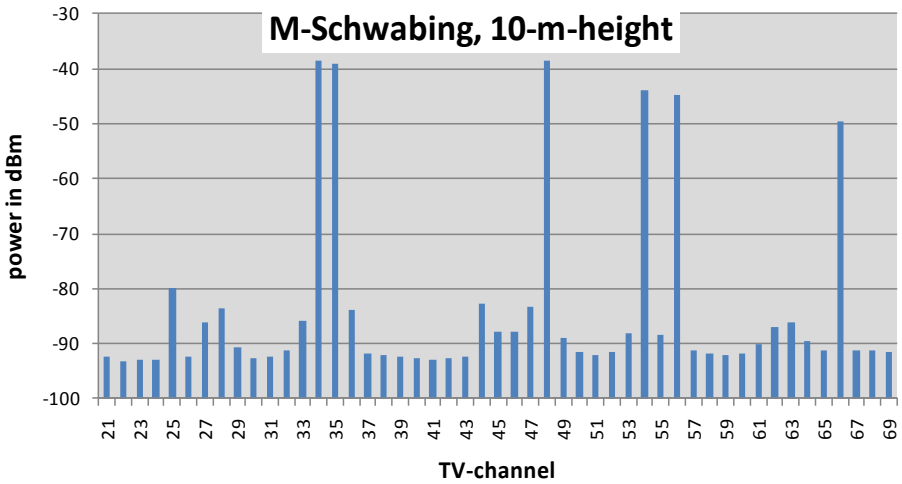
- COGEU supports the EC position that the essential requirement of the R&TTE Directive fully applies to CR devices and they do not need to be amended.
  - Therefore most of the test procedure and relevant measures aiming at ensuring the compliance at different stages of the CR device functioning should be included in harmonised standards (ETSI).

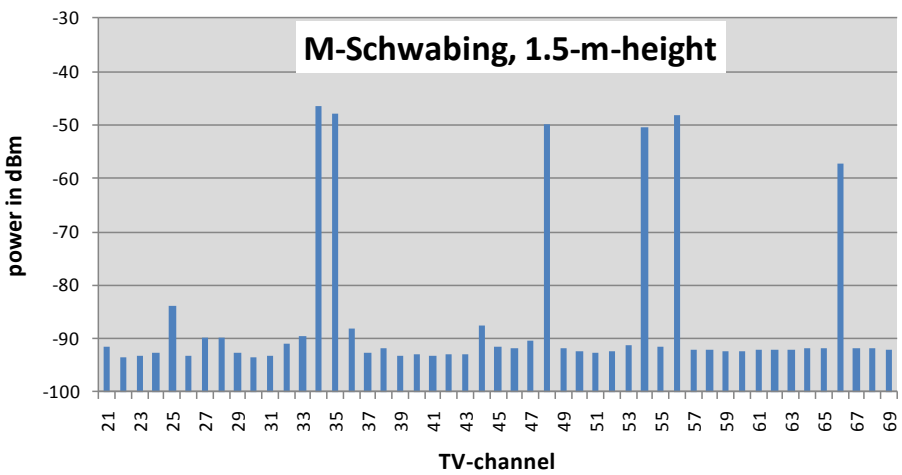
4. Enabling technologies

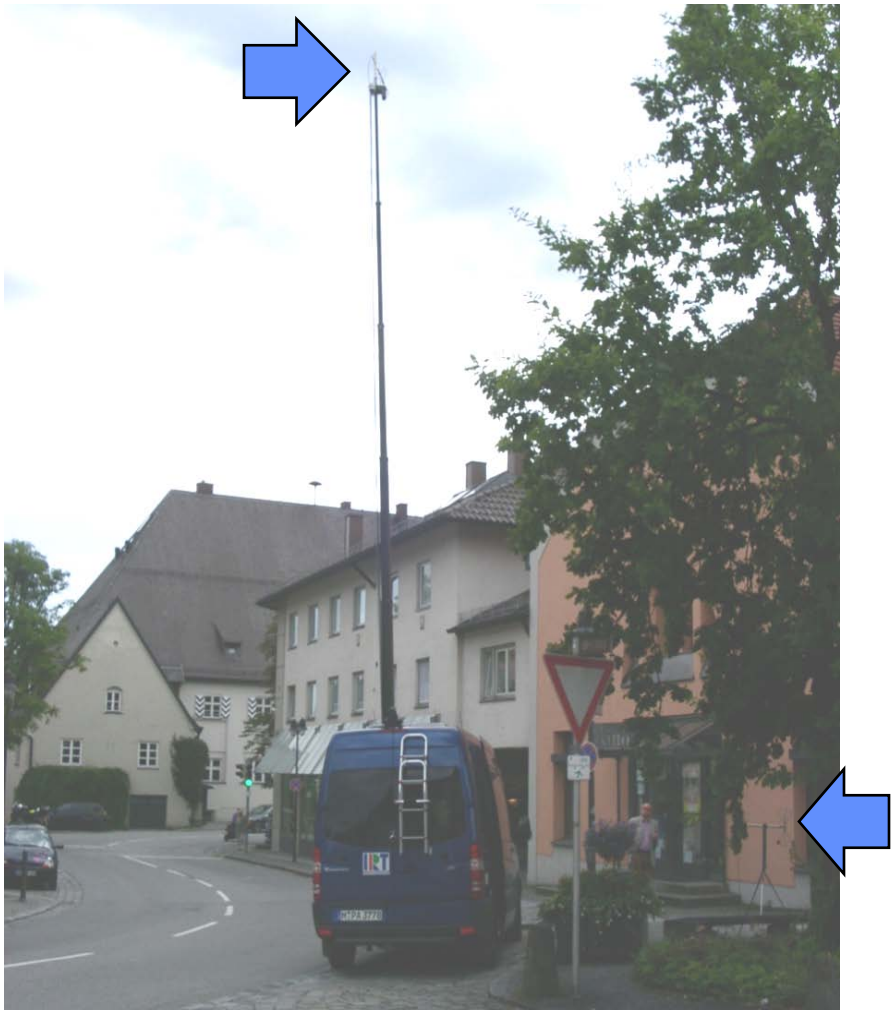
Measurements campaign in Munich



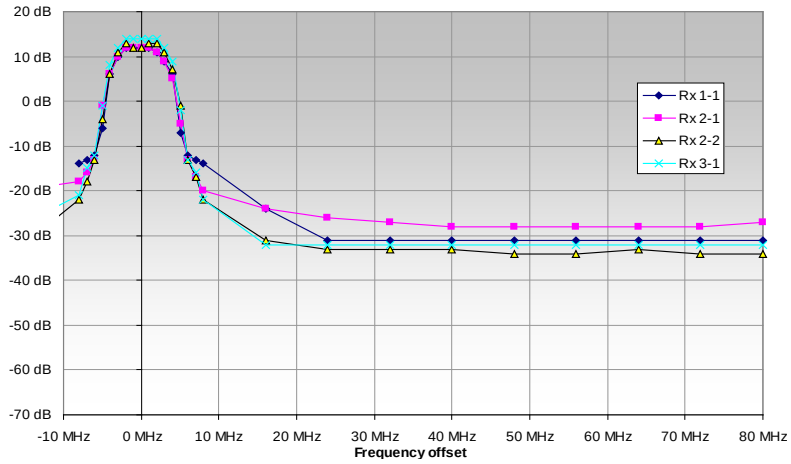
Measurements campaign in Munich

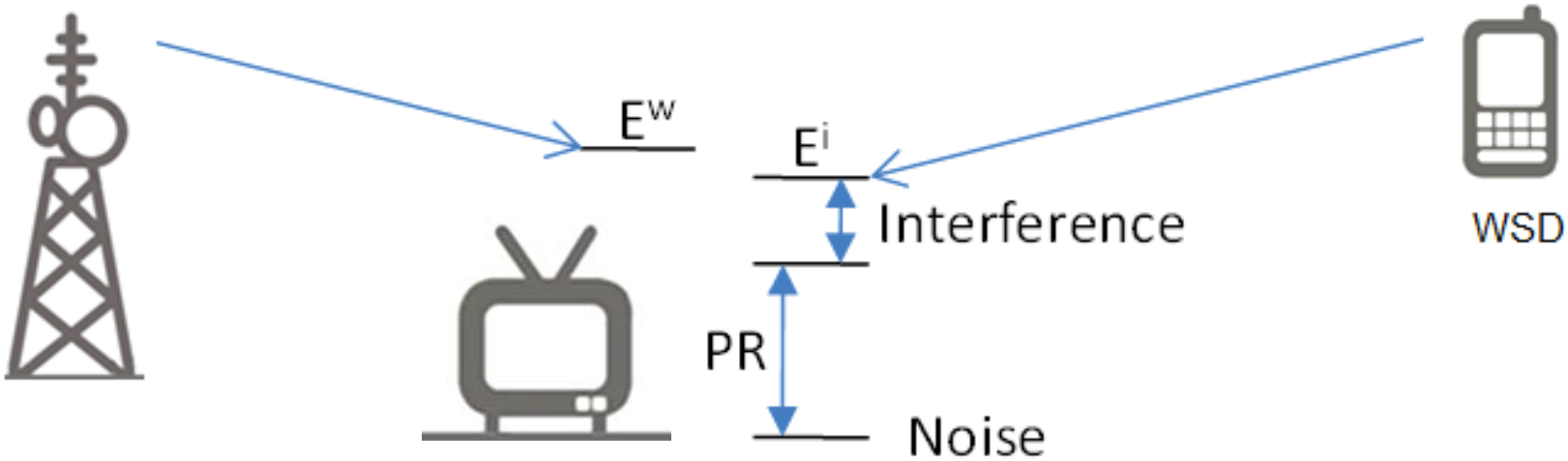


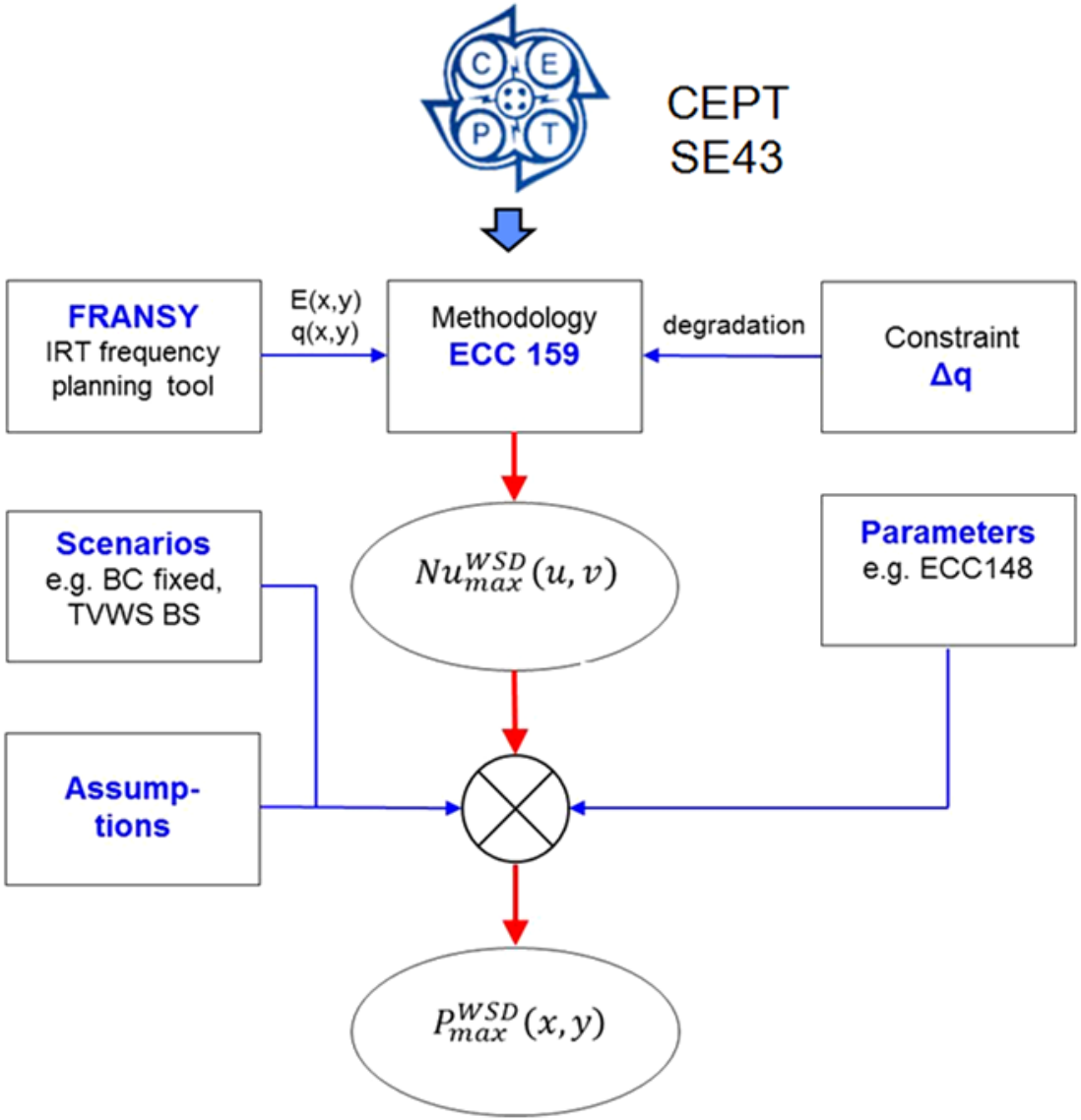




Coexistence testbed




E^w
E^i
Interference
WSD
PR
Noise


CEPT
SE43
FRANSY
IRT frequency planning tool
E(x,y)
q(x,y)
Methodology
ECC 159
degradation
Constraint
Δq
Scenarios
e.g. BC fixed, TVWS BS
$Nu_{max}^{WSD}(u,v)$
Parameters
e.g. ECC148
Assump-tions
$P_{max}^{WSD}(x,y)$

COG EU

COGnitive radio systems for efficient sharing of TV white spaces in EUropean context

Main Page | Show White Spaces | Block White Spaces | PMSE Booking | TVWS Repository | Spectrum BROKER | Policies | Disclaimer

Select Data Base

Munich Database

TV Channel (40-60)

Channel 60 (782-790 MHz)

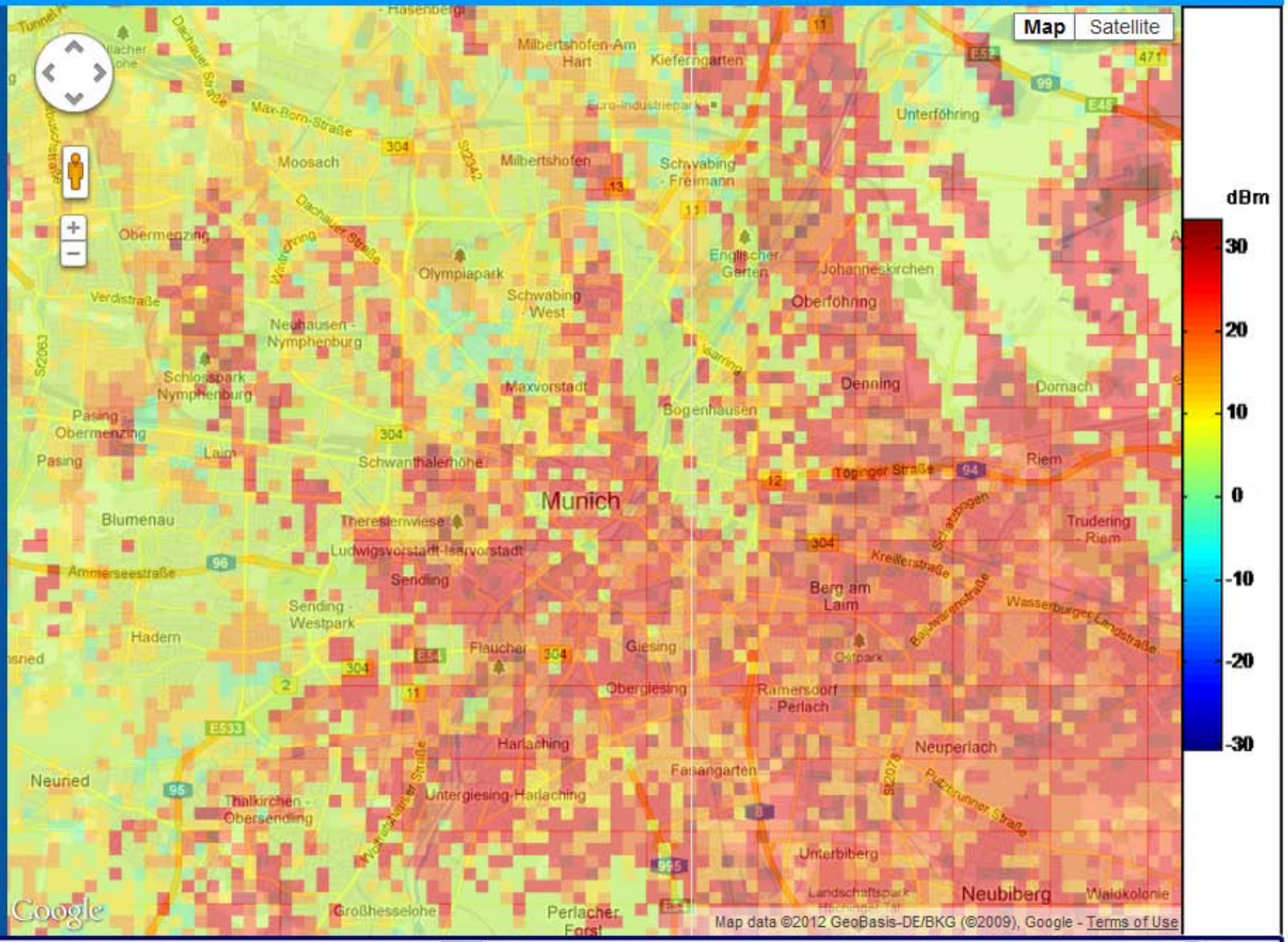
Map Type

Color Scale

- White Spaces
- Gray Scale
- Color Scale
- Chart Point

Address

Download Protection Criteria



SEVENTH FRAMEWORK PROGRAMME

FUTURE NETWORKS

COGEU

COGnitive radio systems for efficient sharing of TV white spaces in EUropean context

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HOME MAPS BOOKING ABOUT

WELCOME TO COGEU PMSE BOOKING PLATFORM

We provide the freedom of spectrum YOU need

Booking on frequency, time and spatial dimension
User-friendly platform
Real-time spectrum coordination

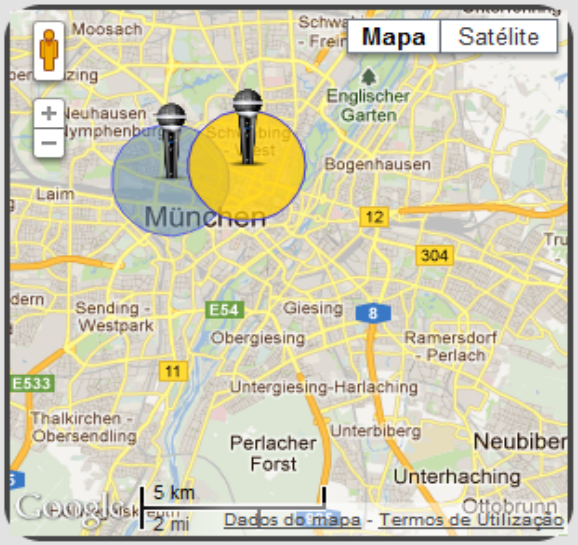
HOME MAPS BOOKING ABOUT

SUMMARY: Thu Apr 12 2012 12:03:41 GMT+0100 (GMT Daylight Time)

ALL BOOKED PMSEs: **3** TODAY's BOOKED PMSEs: **0**

Welcome:
id: 6, pmarques
Your account balance:
2865€

Map



Your Books

Ch	Latitude	Longitude	Date	Nº of Links		
20	48.1464	11.54	2012-04-13	1	Show	Erase
29	48.1501	11.5682	2012-04-17	1	Show	Erase
29	48.1501	11.5682	2012-04-18	1	Show	Erase

QUERIES:

PMSEs TODAY:
See on Map

ALL PMSEs:
See on Map

Search PMSEs by Channel:
<-- Choose Channels

Search by Date:

From:
Apr 12 2012

To:
Apr 12 2012

See on map

Channels:

20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	
40	41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60	

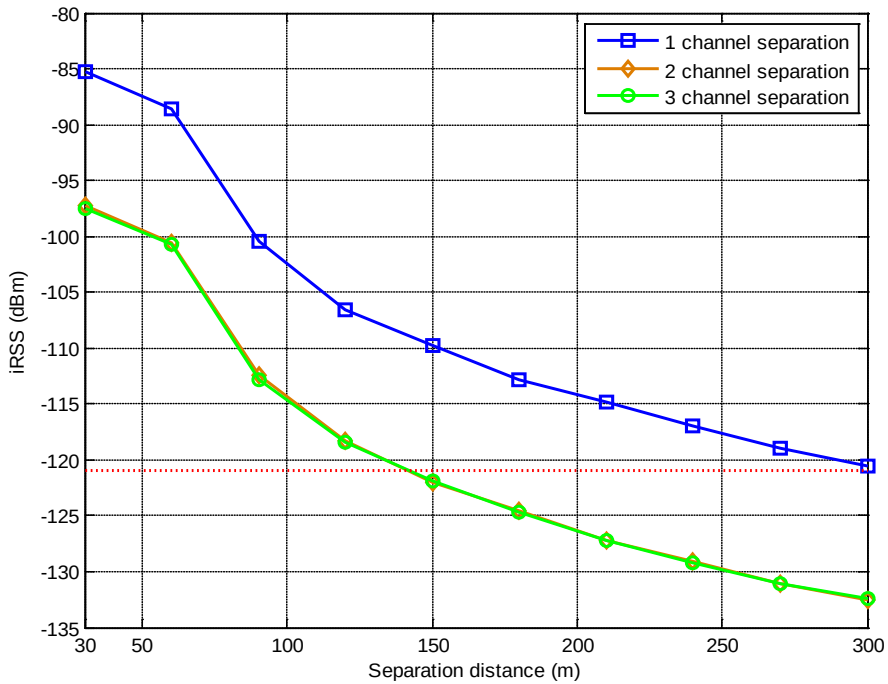
Add new book Options ^

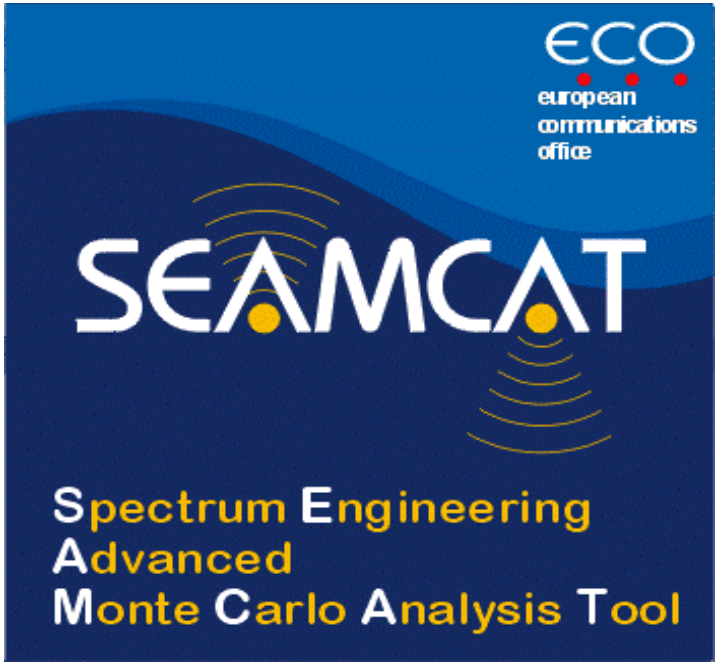
Report a Bug Block Area

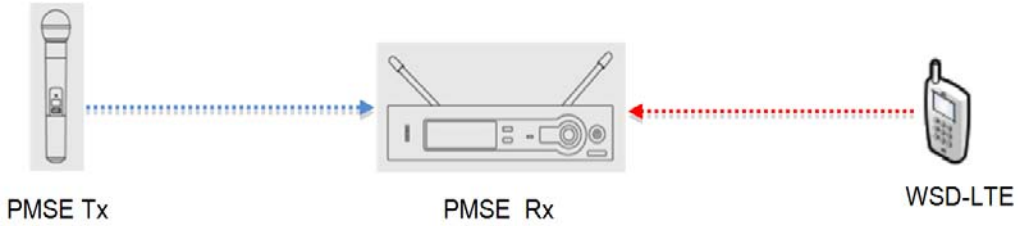
Logout Recharge Account

Try it – just “Google” COGEU !

PMSE exclusion area







Combination of PMSE sensing with database access

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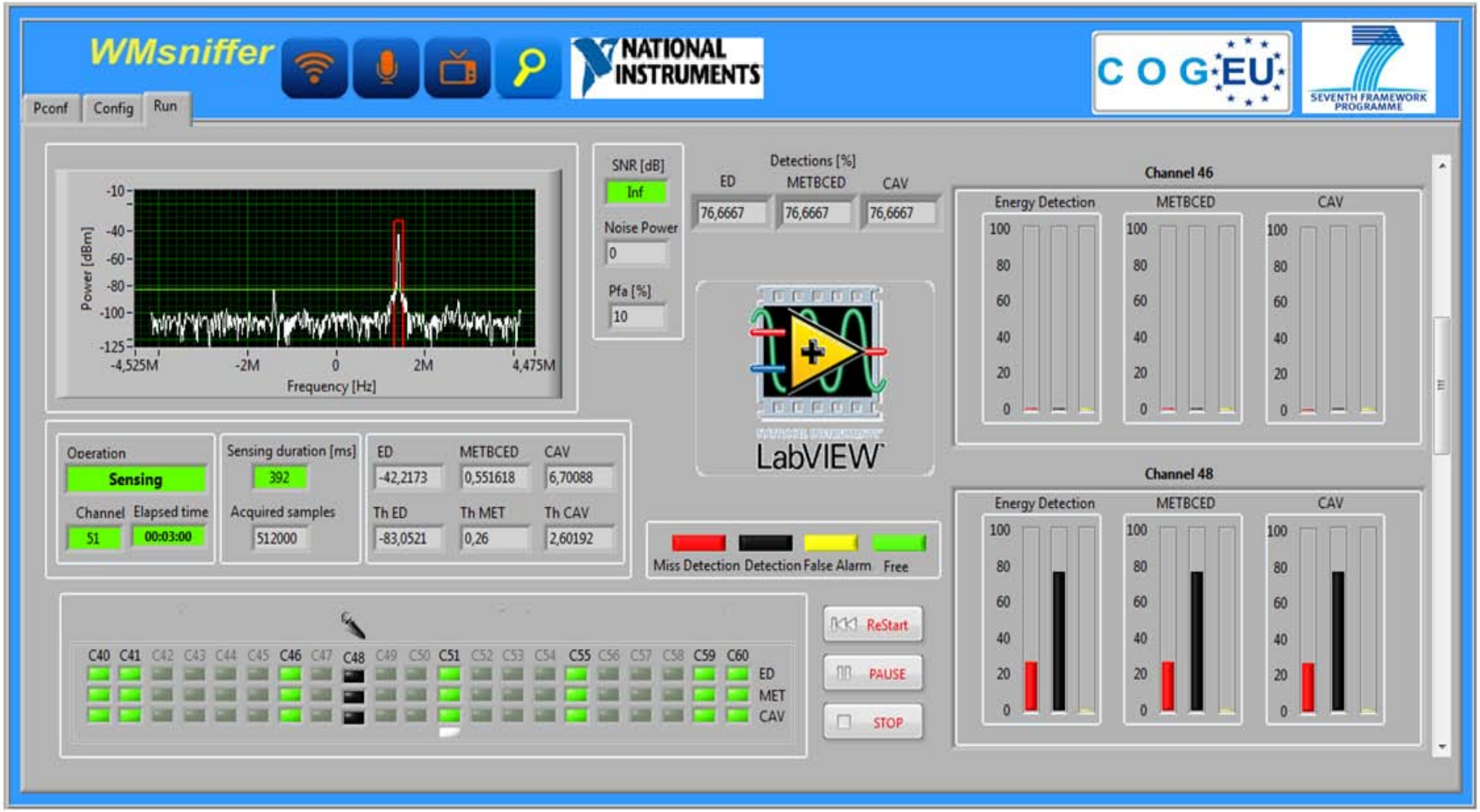
Combination of PMSE sensing with database access



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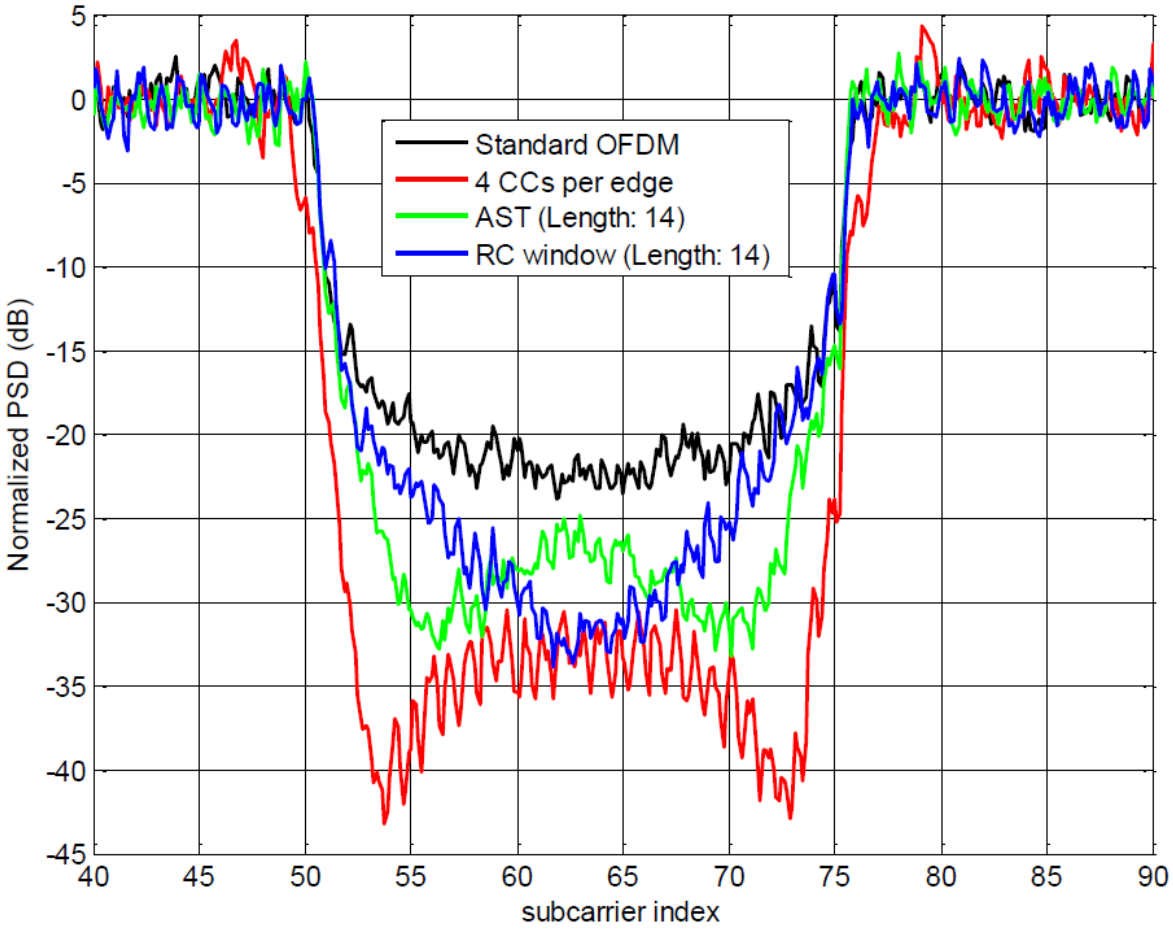
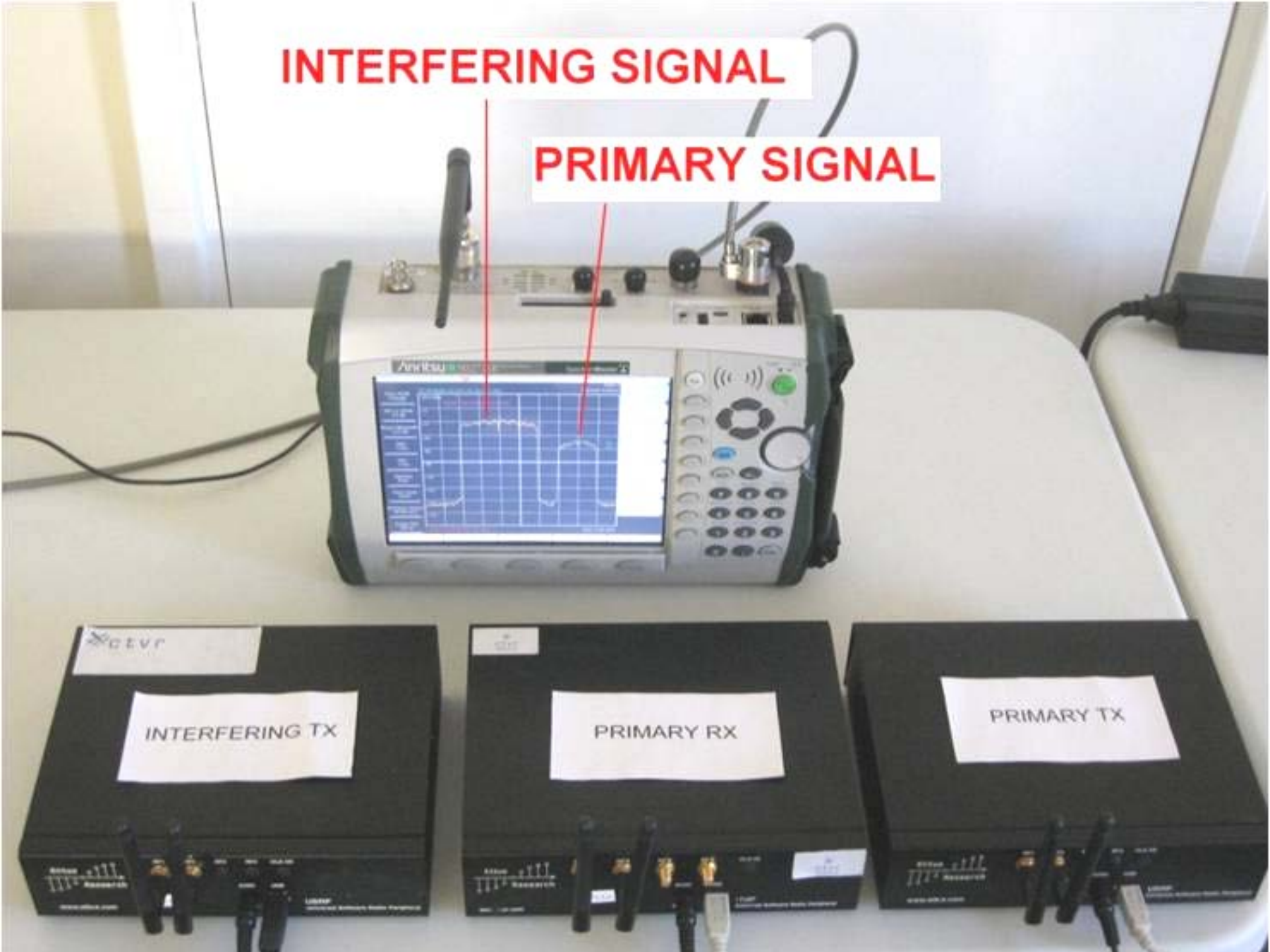
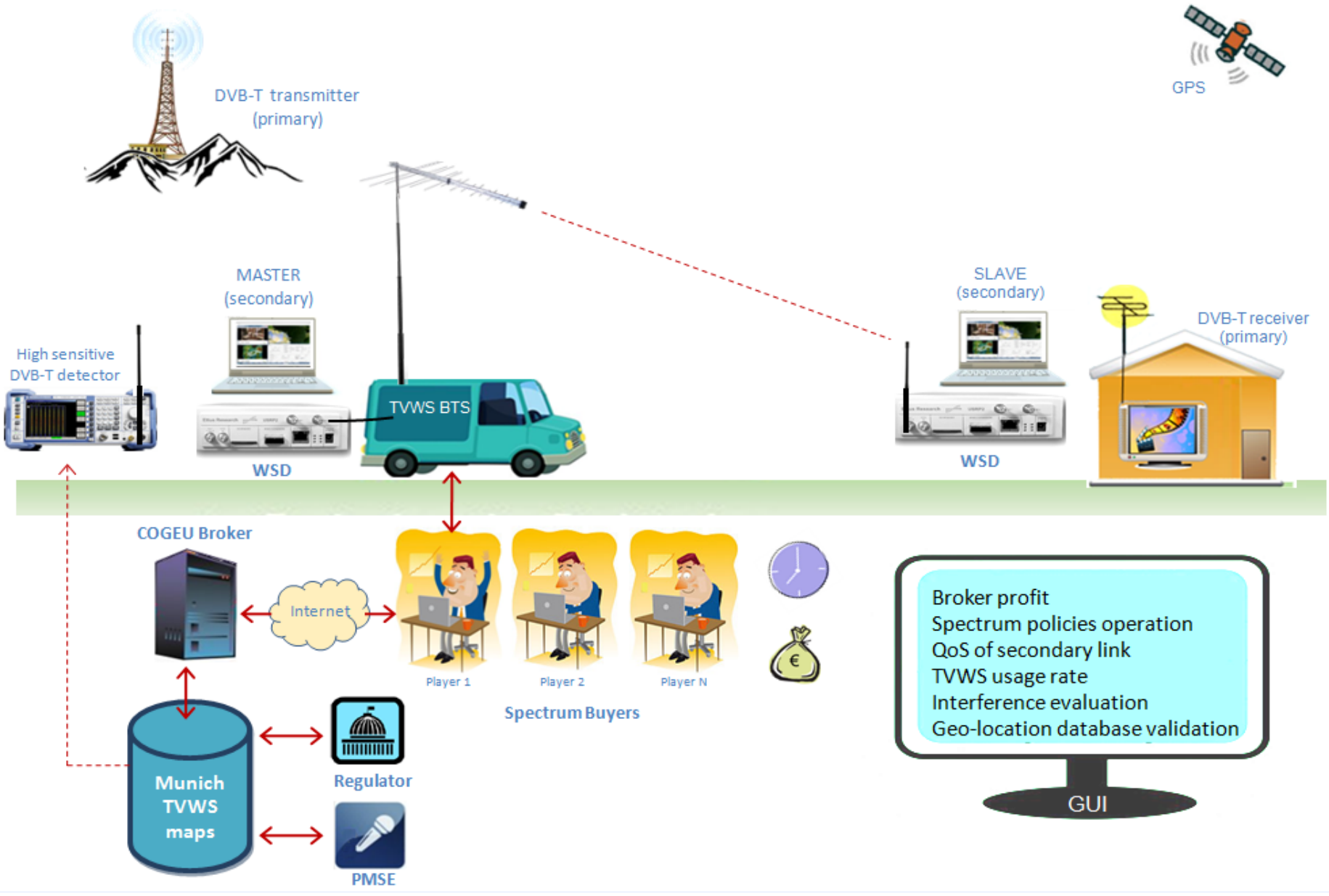
Spectrum shaping

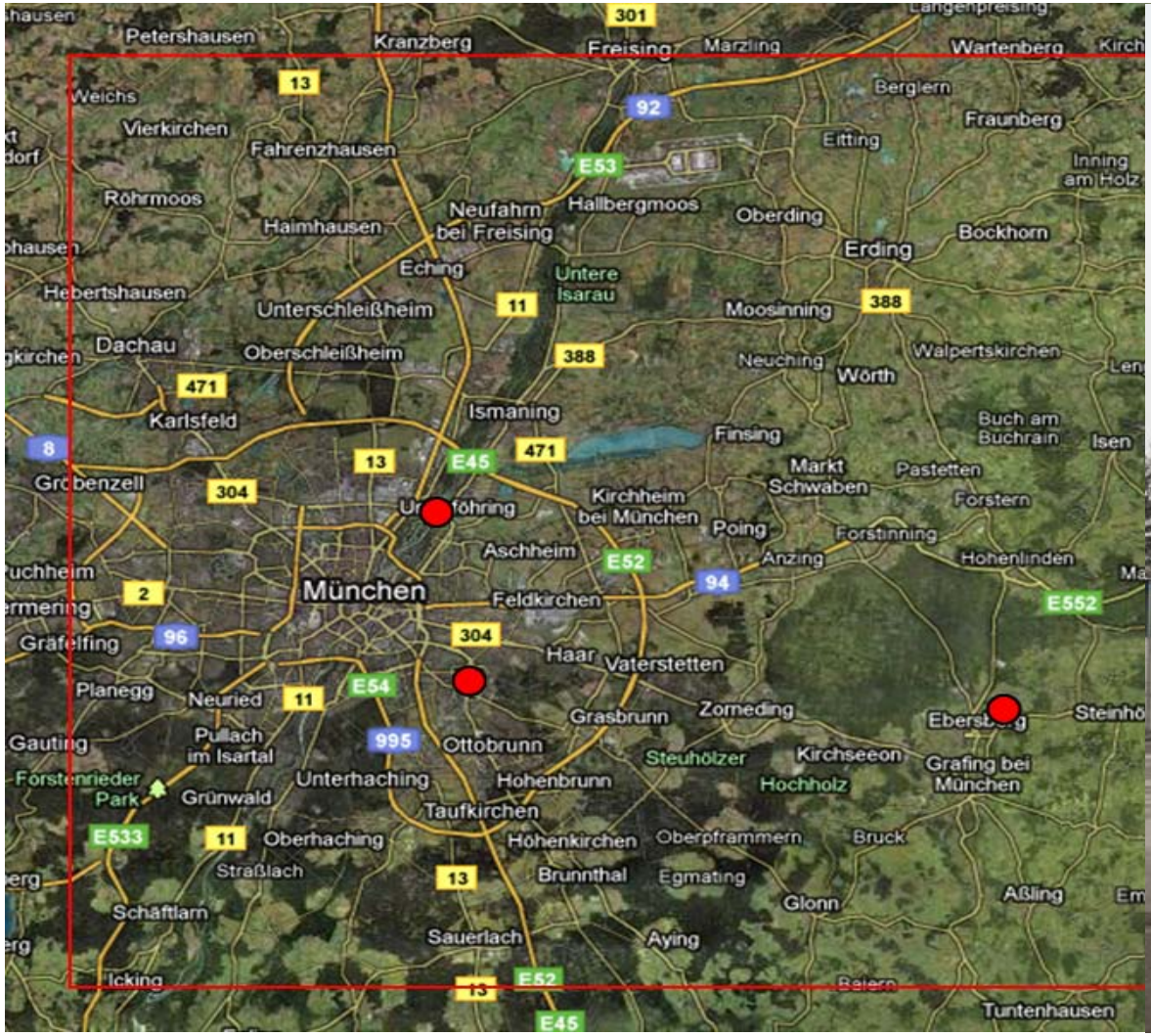



INTERFERING SIGNAL
PRIMARY SIGNAL
INTERFERING TX
PRIMARY RX
PRIMARY TX

COGEU final demo



TVWS trials in Munich – June 2012



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Gdańsk
Hamburg
Bremen
Berlin
Warsaw
Poznań
POLAND
Oder
Łódź
Wrocław
Elbe
Vistula
Essen
Leipzig
Cologne
GERMANY
Bonn
Prague
Kraków
Frankfurt
am Main
CZECH REPUBLIC
Luxembourg
Brno
SLOVAKIA
Banska Bystrica
Stuttgart
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- Deliverables
- Dissemination
- Demos
- Reviewers Area

Can Europe make use of TV White Spaces?

COGEU-workshop

10 November 2011
09:00-17:00

Presentations and Gallery

Take a look at COGEU initial demos!

Click here to test the COGEU TVWS geo-location database and online spectrum broker!

COGEU is organizing a Workshop

COGEU is organizing a workshop on the on the efficient use of TV White Spaces in Europe.

The aim of the workshop is to stimulate discussions and exchange of ideas between the COGEU team, invited speakers and the audience as well as to validate COGEUs views and approaches about an efficient use of TV white spaces in European context.

Flyer

Register Here

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