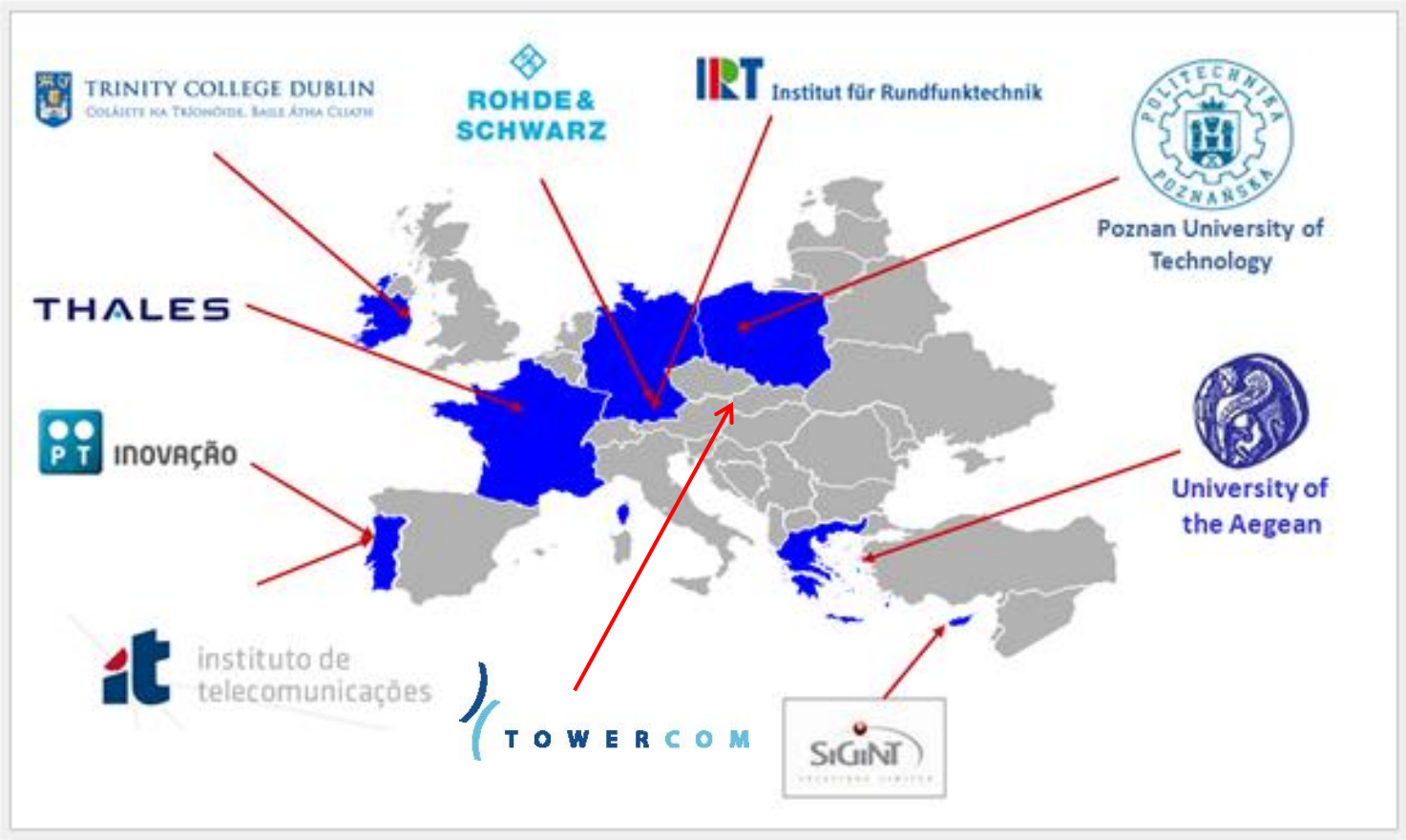
Cognitive radio systems for efficient sharing of TV white spaces in European Context

Consortium and External Advisory Board

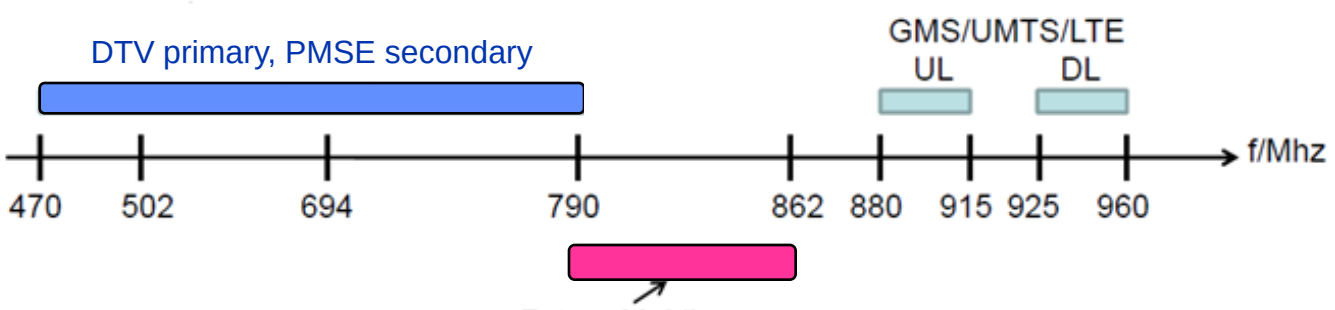


January 2010 – December 2012

Motivation

- In Europe the complete digital switchover is planned for 2012 and will open a "once in a lifetime" opportunity for the network of the future.

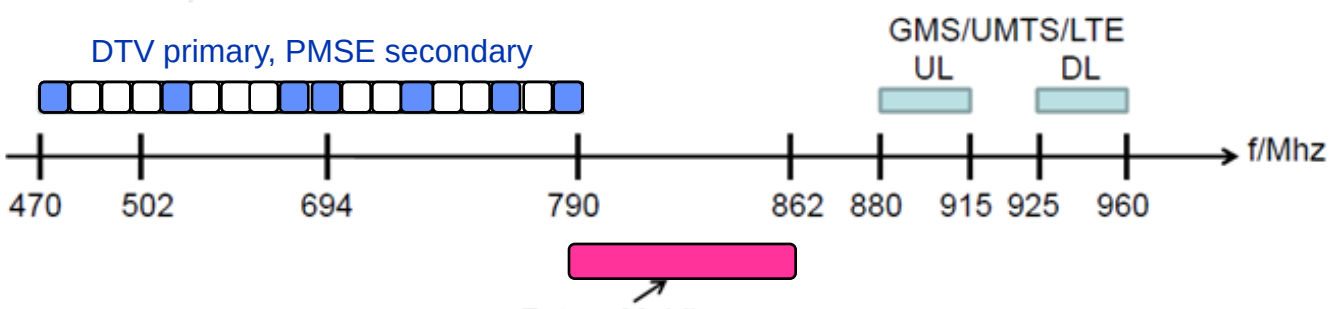
- By switching from analogue to digital transmission more television channels can be broadcast using less spectrum. After analogue switch off the 790 MHz to 862 MHz spectrum (ch. 61 to 69), the so called digital dividend, will be/was entirely cleared from broadcast .



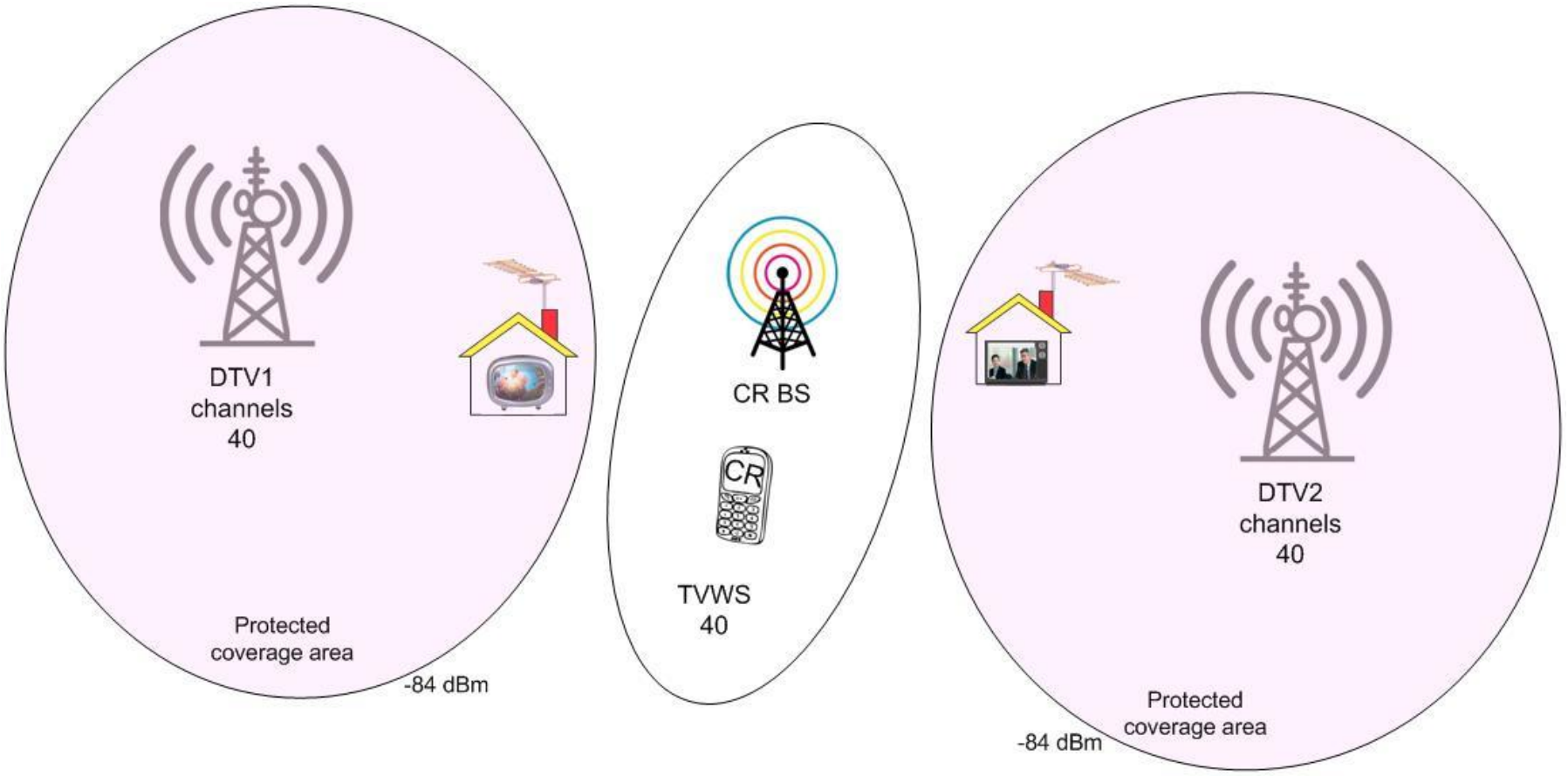
Motivation

- Within the remaining spectrum (470 MHz to 790 MHz) not all channels are occupied at each location. **These locally unused channels are called TV White Spaces (TVWS).**

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



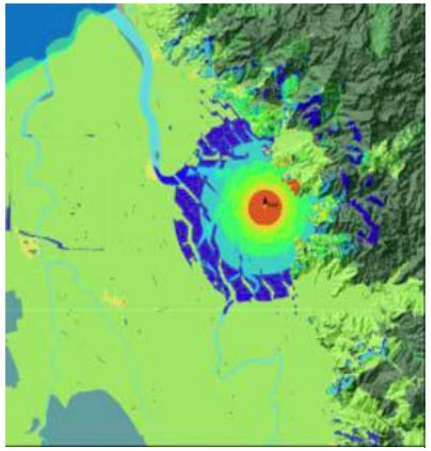
TVWS-Interleaved Spectrum



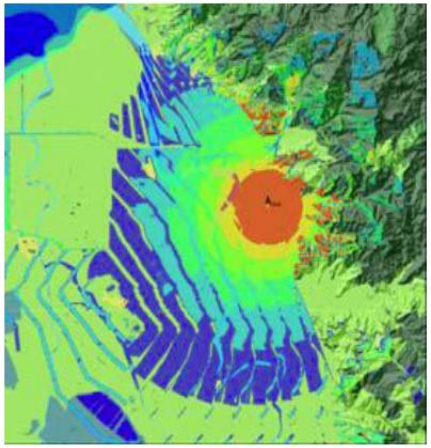
Why are TVWS so valuable ?

- 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 reduced.



2.6 GHz coverage

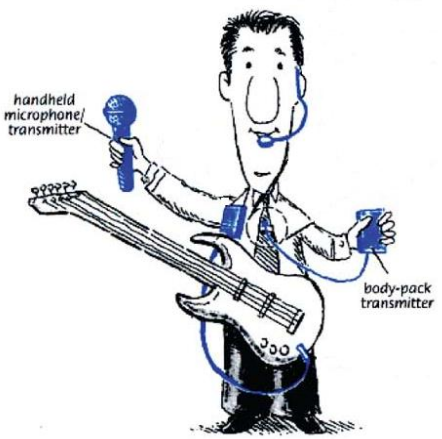


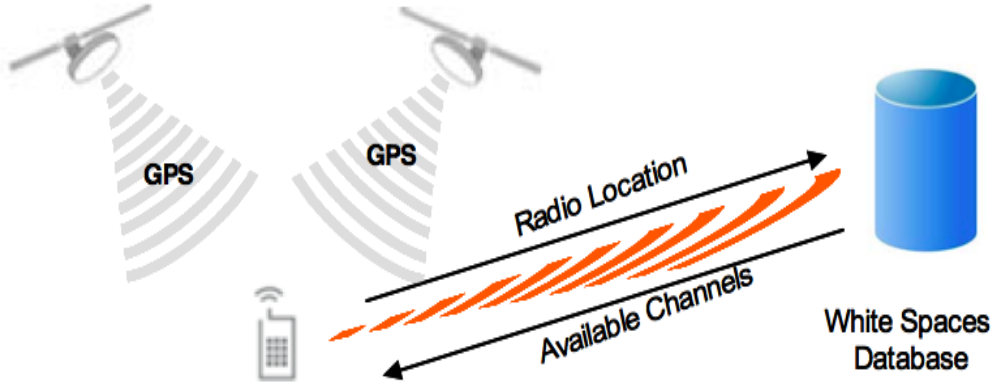
700 MHz coverage

Attractiveness of TV White Spaces

- Broadcaster operation can be protected by a geo-location database with a list of vacant channels and associated transmit powers (FCC, OFCOM).

- However database cannot protect all Wireless Microphones applications. **Deadlock:** the only practical solution is move WM to "safe harbor" channels, reallocation costs.





COGEU objective

- The main objective of the COGEU project is to design, implement and demonstrate enabling technologies to allow **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.
- **Aid the European decision makers** to move the TV spectrum management paradigm towards a more liberal and **efficient method**, by providing sufficient evidence on the technology, its economic viability and its deployment.

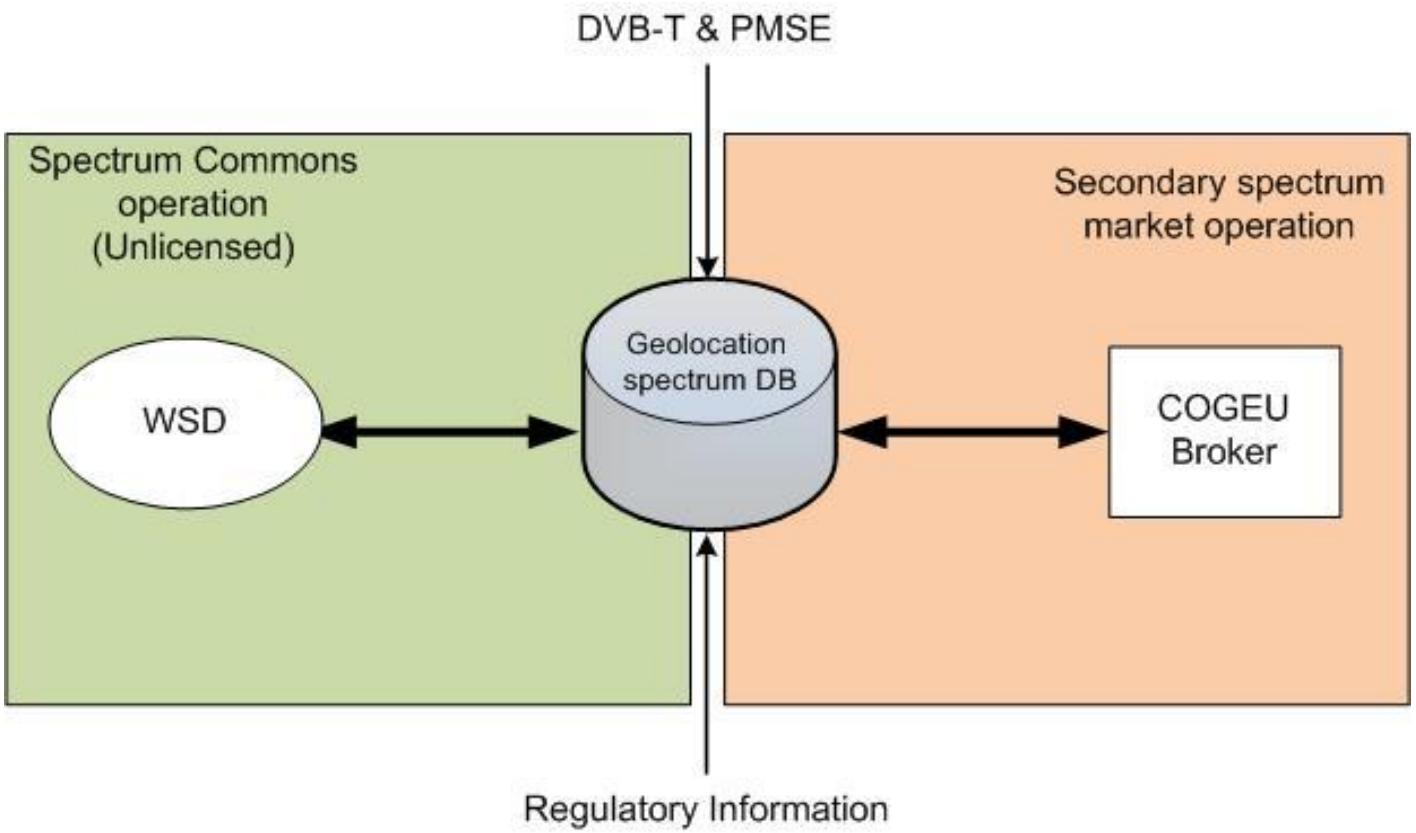
COGEU model

- Currently, only unlicensed access to TVWS is envisaged\allowed by regulators, typically for low power applications (CEPT, OFCOM, FCC);

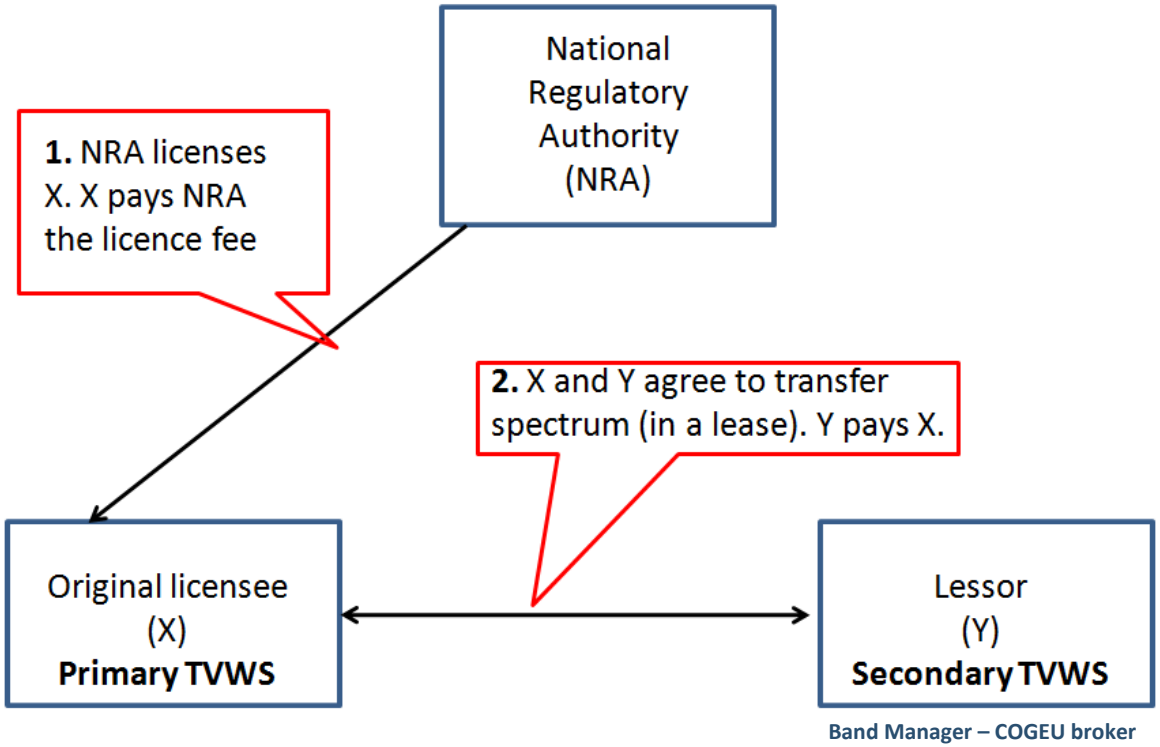
- COGEU investigates an **extension of this regulatory regime** and proposes a secondary spectrum market of TVWS that can leverage the value of these underutilized bands.

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

COGEU model

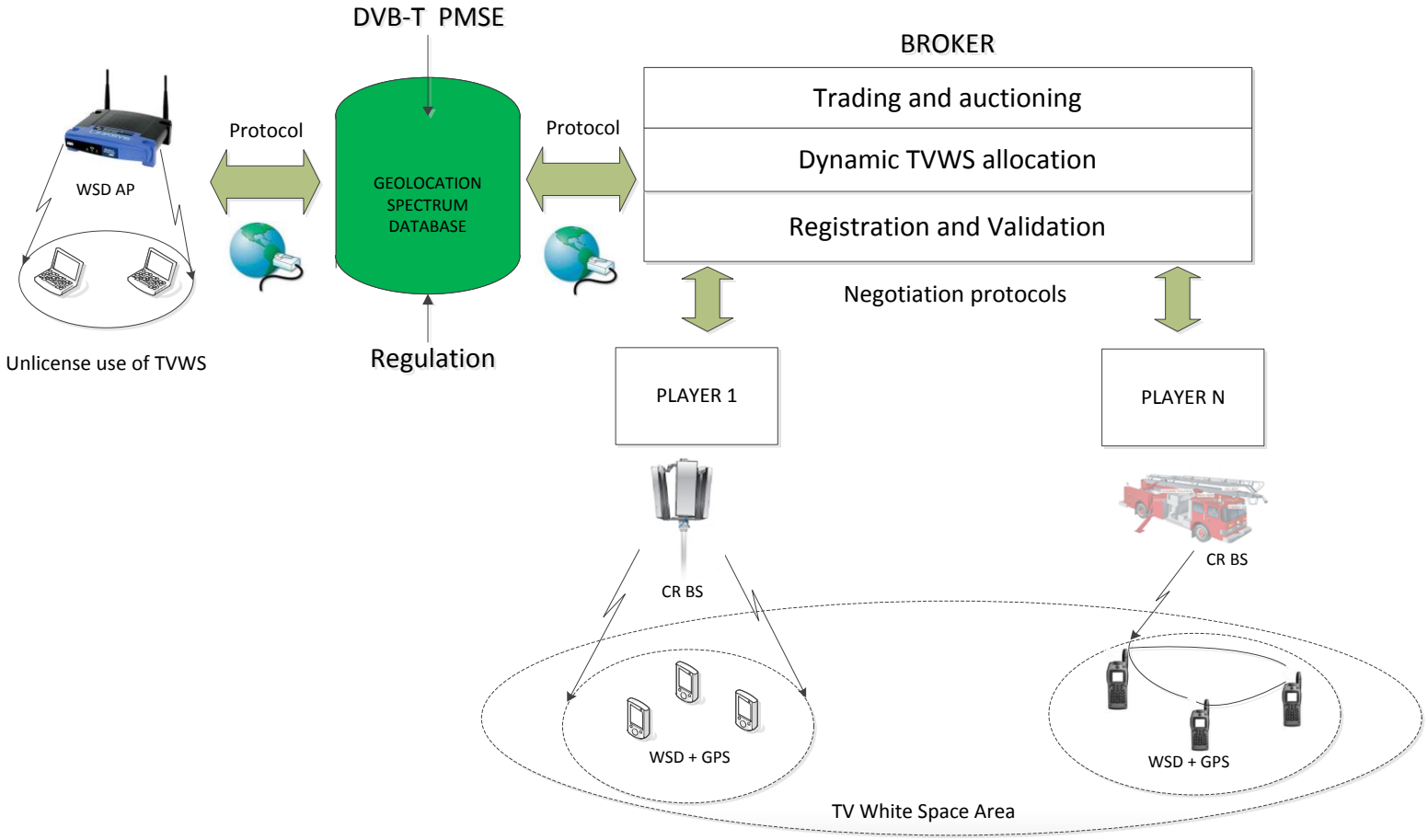


Reducing the bureaucracy of the trading process



- Spectrum Leasing (COGEU approach): removes the NRA from much of the bureaucracy of the trading process, developed under Article 9(b) of Directive 2009/140/EC

COGEU model



COGEU model

- COGEU goes beyond the free (unlicensed) model for TVWS (FCC US ; Ofcom UK) → business models for free access to TVWS has to deal with low QoS.

- Secondary spectrum trading of TVWS: temporarily guarantee access to TVWS with QoS → **entrance of new players and increase competition in the telecommunication sector**.

- Challenge: Broadcasters (primary users) currently have little incentive to coexist with TVWS devices → **Broadcasters need to be part of the value chain.**

COGEU as 3rd option for spectrum supply

Spectrum demand

Spectrum supply

?

Buy new spectrum with exclusive Rights

- National wide spectrum blocks can enhance operators' market scale and international harmonization, e.g., the digital dividend, 800 MHz band.

Optimize current own spectrum

- Increase spectrum eficiency
- Better frequency planning
- Better coexistence strategies
- Re-assign own spectrum (WAPECS-technology neutral)

COGEU as 3rd option for spectrum supply

Spectrum demand

Spectrum supply

?

TVWS

- Secondary Spectrum Market with temporary exclusive rights
- New spectrum commons bands

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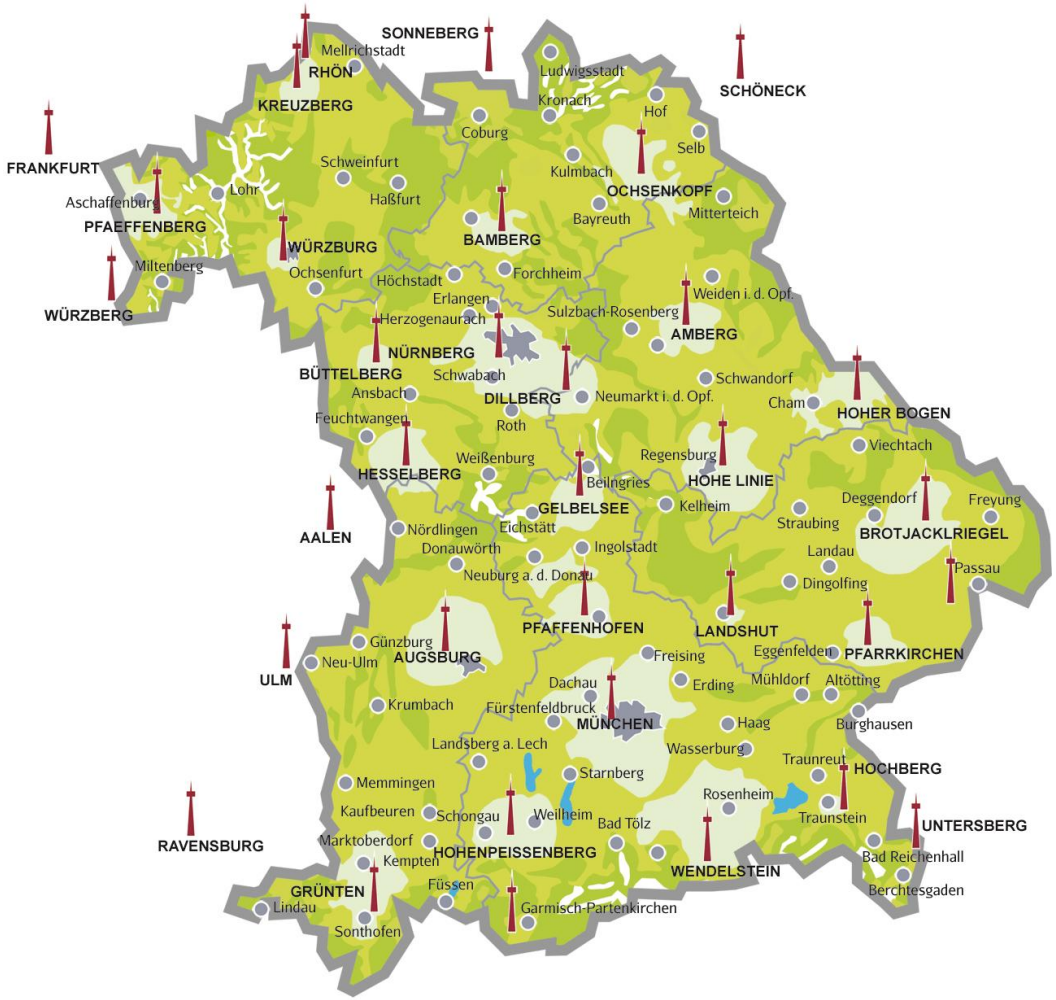
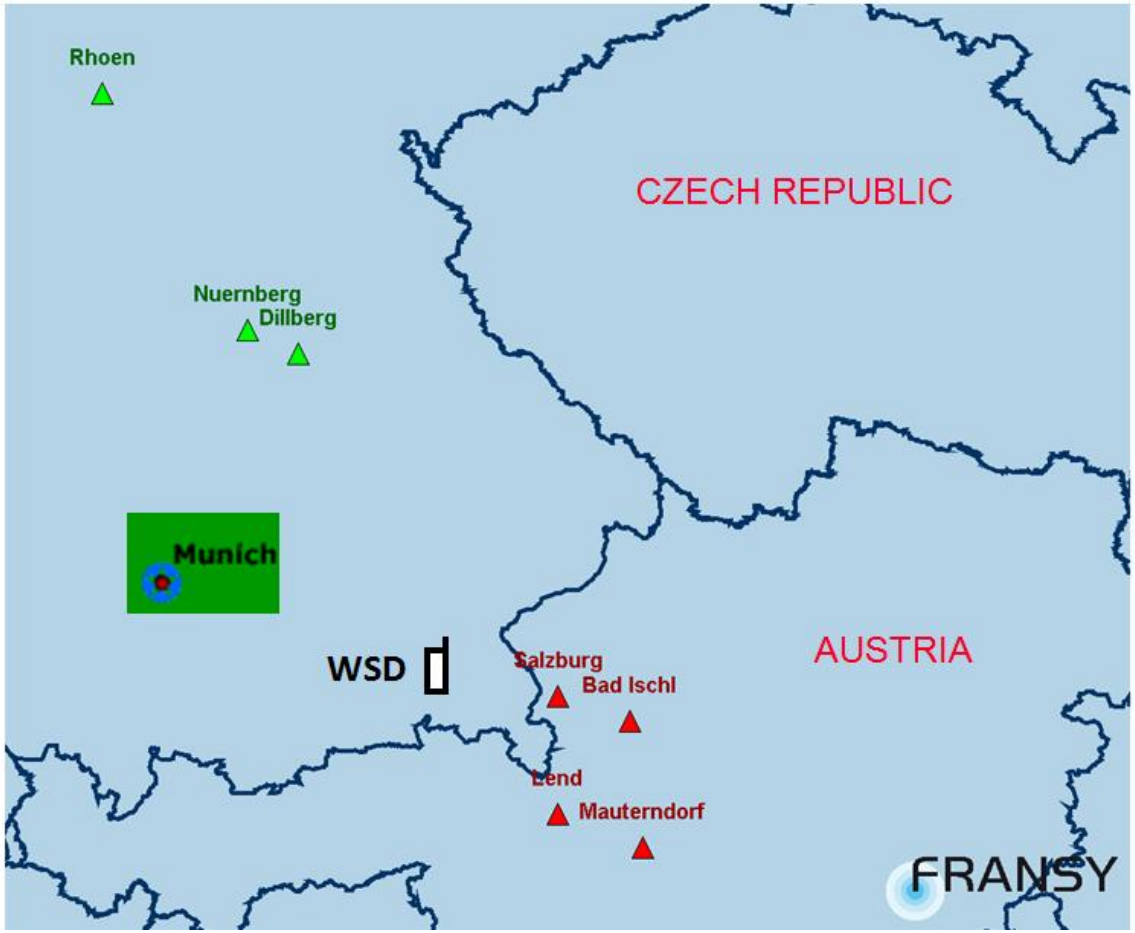
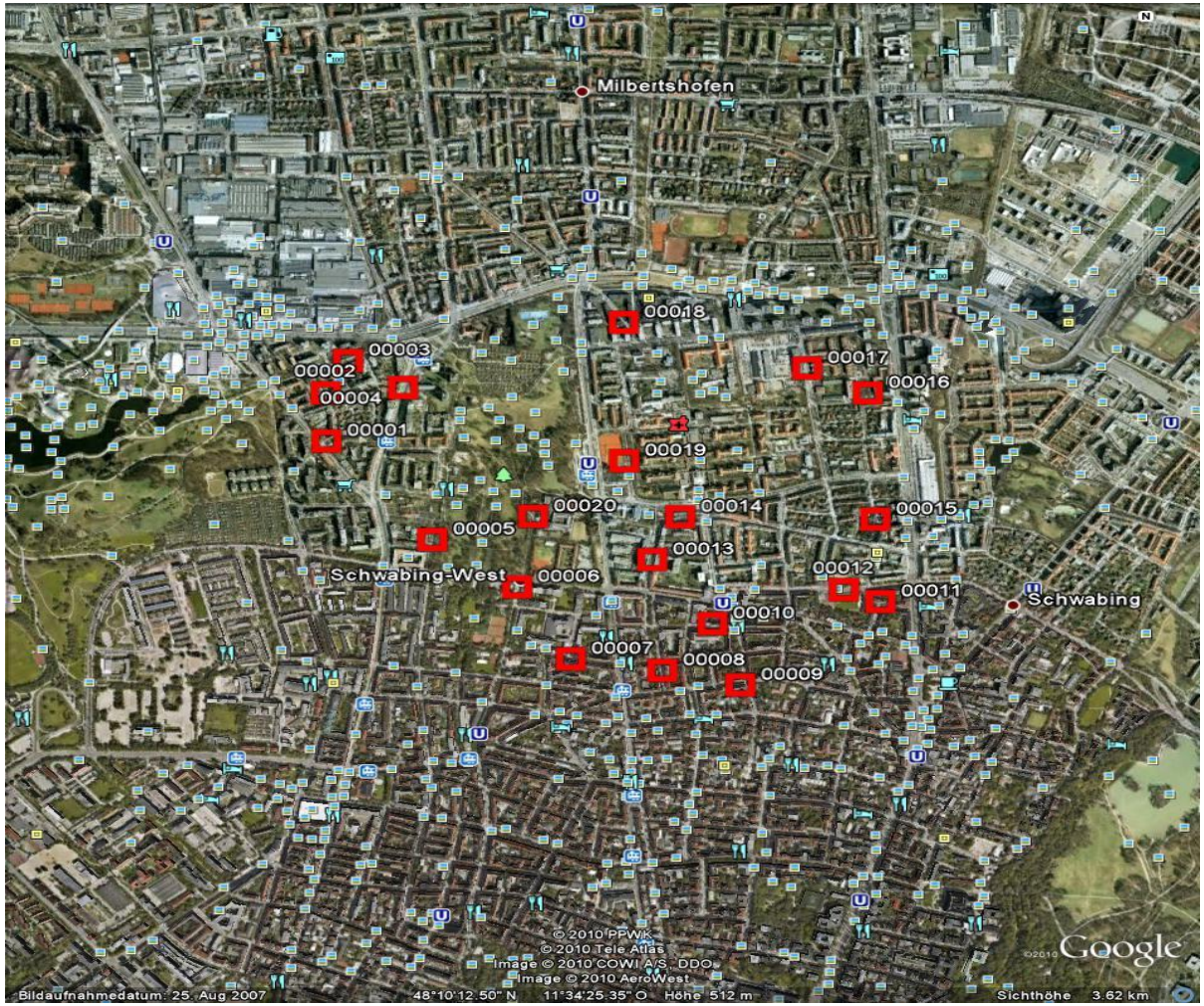
TVWS measurements
Broadcaster Transmitters in Bavaria (Germany)



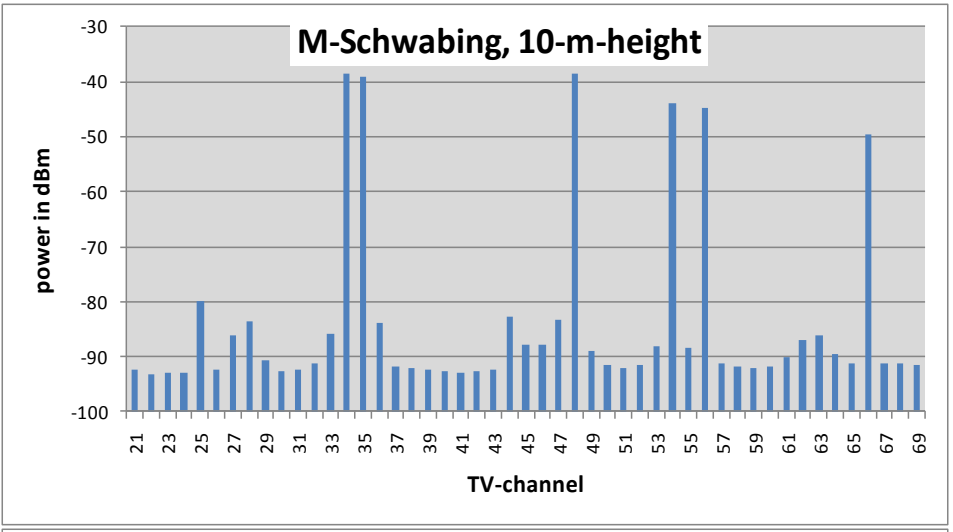
Cross border issues

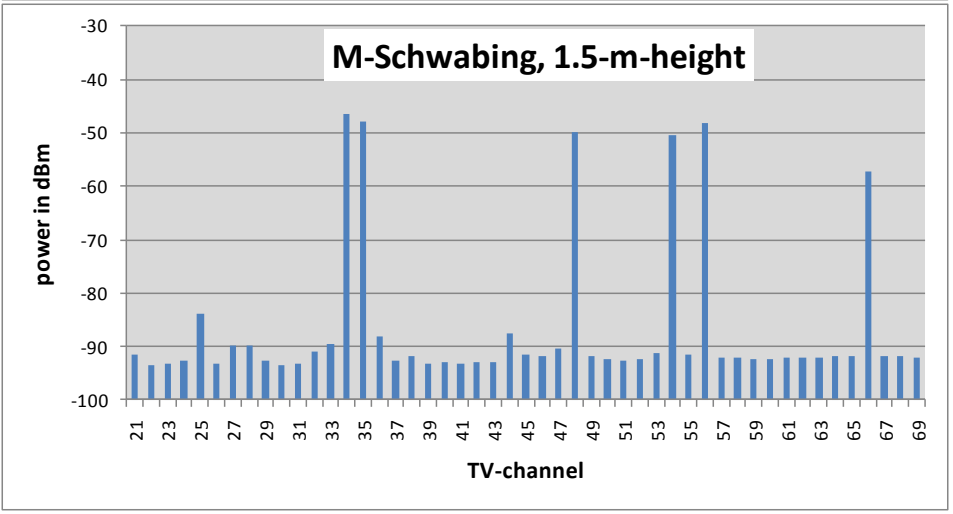


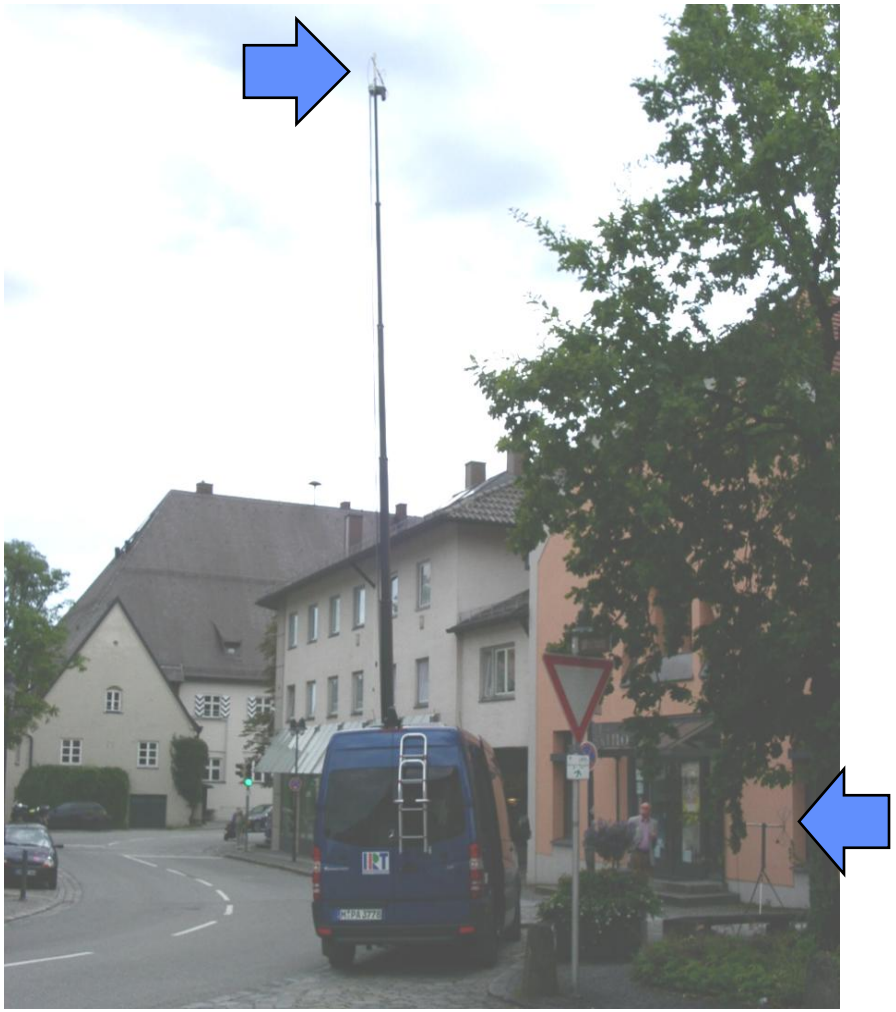
TVWS measurements
Munich-Schwabing (Urban area)



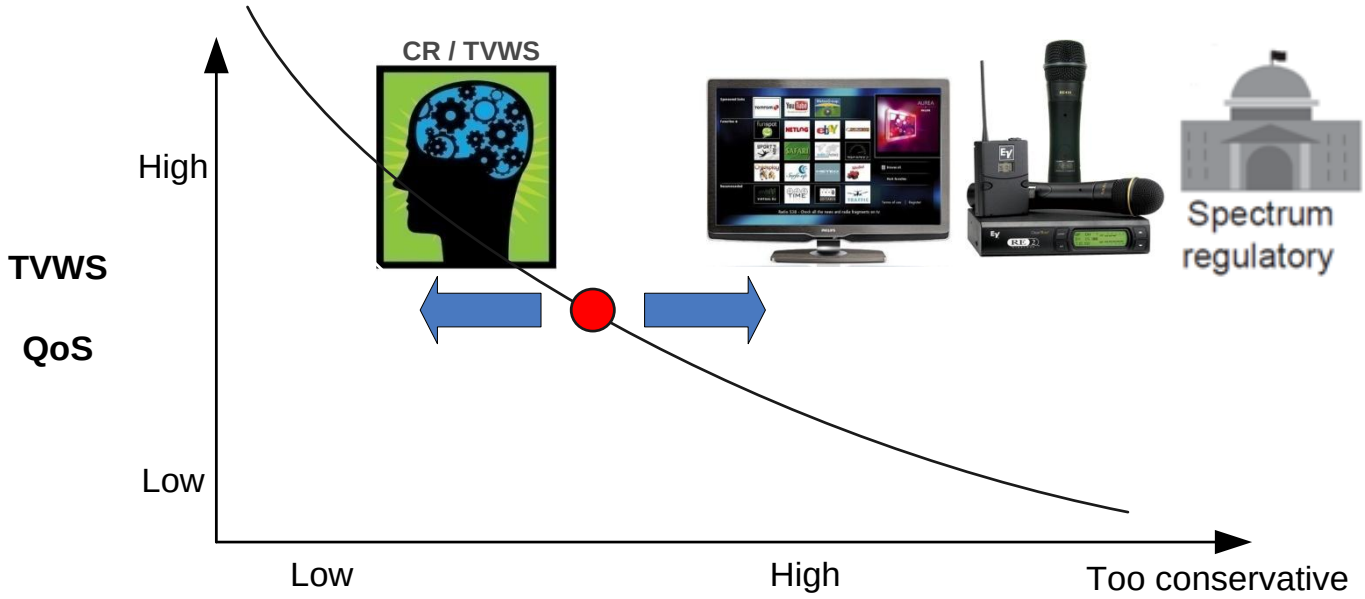
Measurements campaign in TV bands







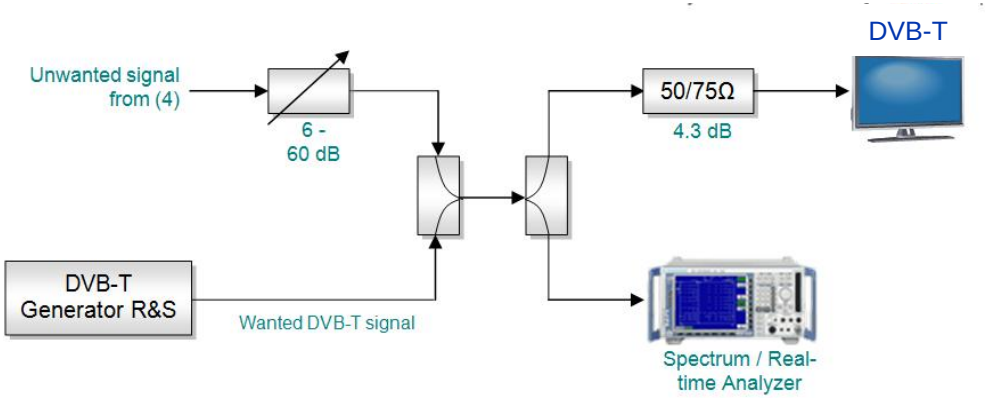
COGEU is in the protection requirements battle (CEPT SE43)

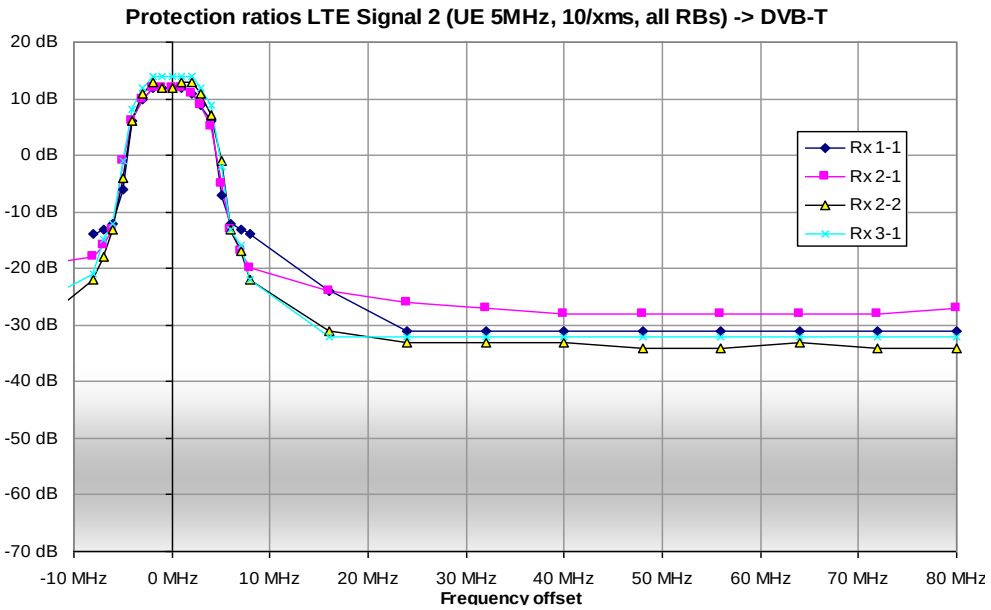


Protection requirements of existing services in TV bands

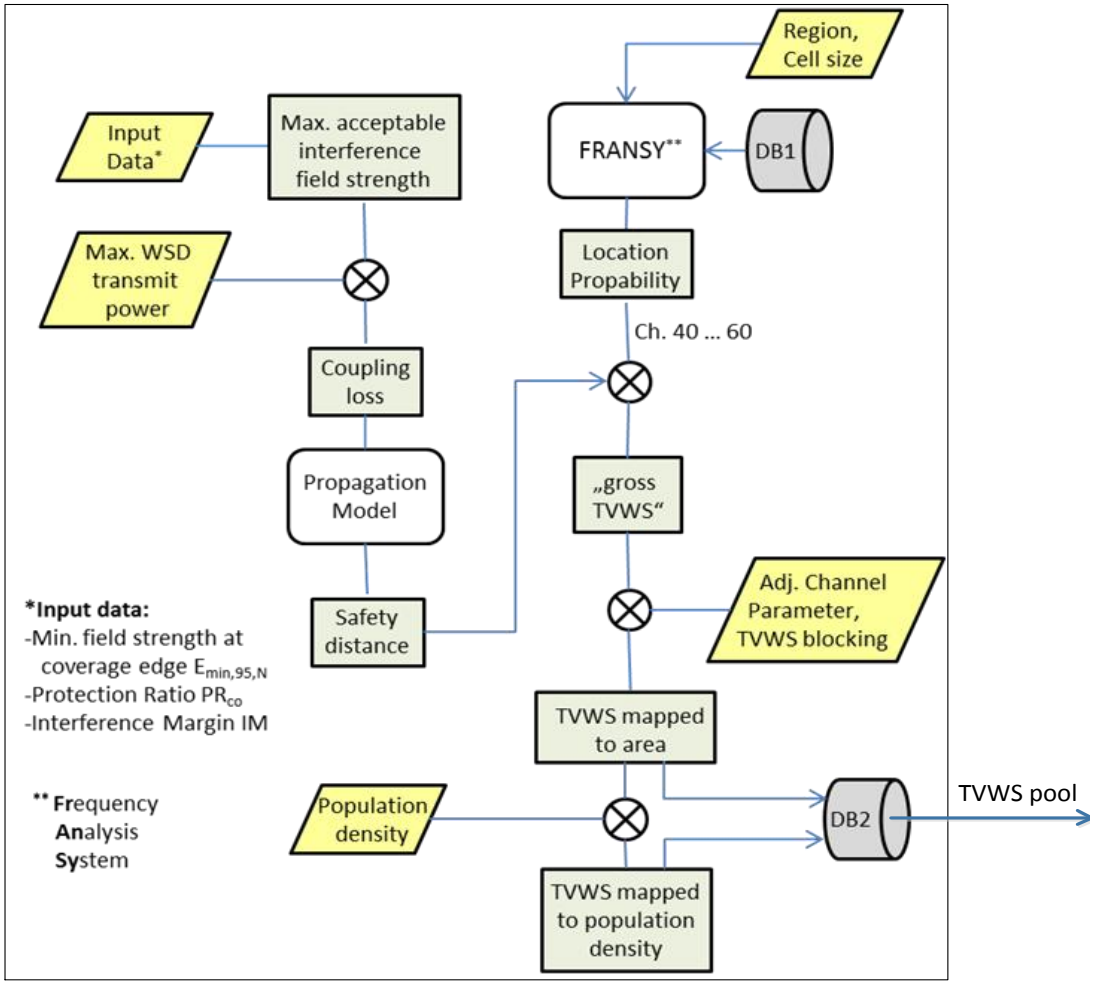
- TVWS availability depends on location and the protection requirements of incumbent services.

Protection requirements between DVB-T and LTE over TVWS: coexistence testbed





COGEU methodology to compute TVWS



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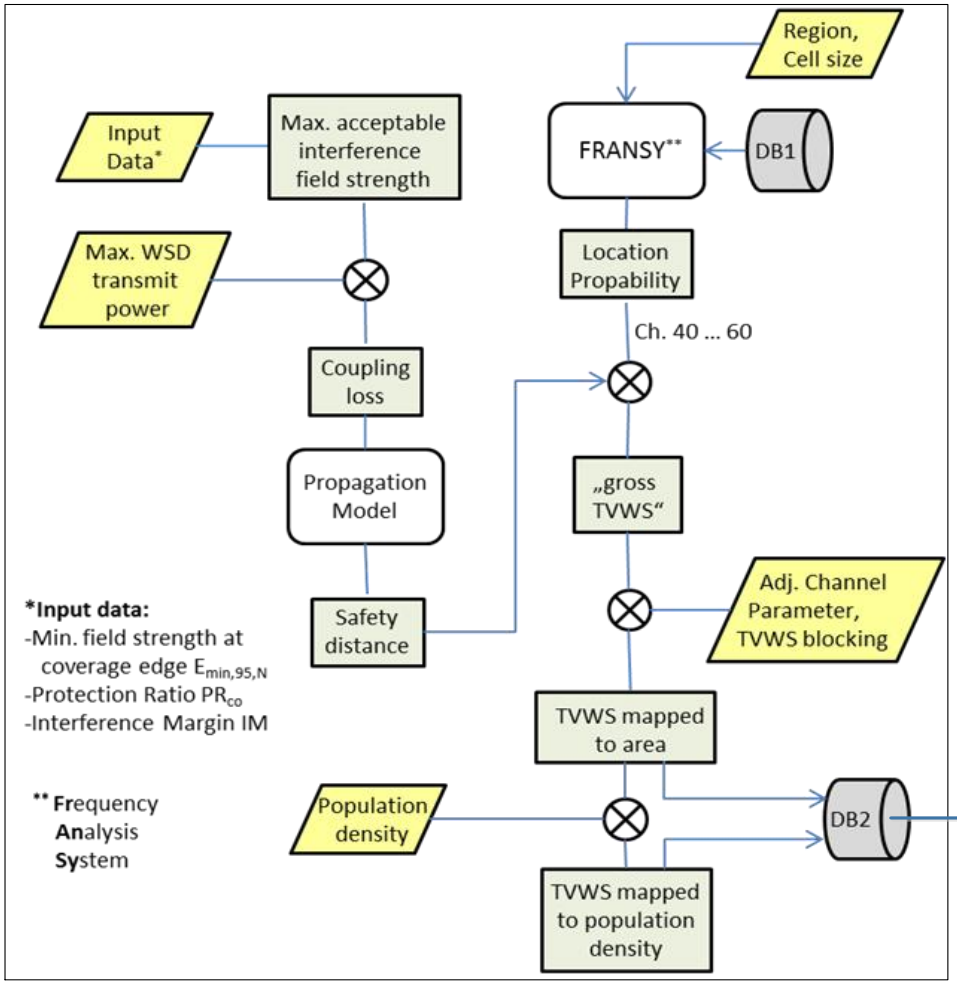
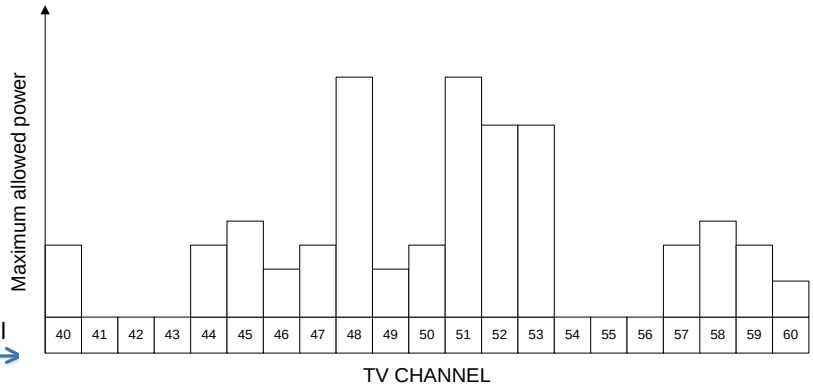
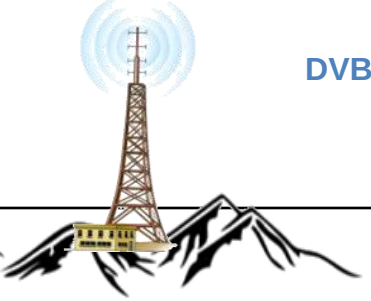


TVWS pool



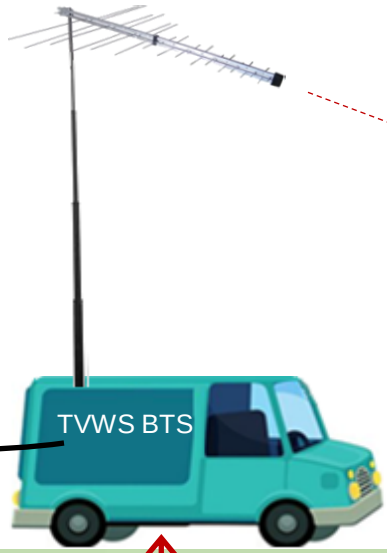
COGEU validation in 3 scenarios



DVB-T transmitter
(primary)

GPS

MASTER
(secondary)



SLAVE
(secondary)

DVB-T receiver
(primary)

COGEU Broker

Internet

Spectrum Buyers

Broker profit
QoS of secondary users
TVWS usage rate
Interference evaluation
Geo-location database validation

GUI

Munich TVWS maps

Regulator

CTVR

COGEU regulatory requirements

1. COGEU assumes that a database for professional PMSE is either available or will be built up in advance of introduction of white space-using equipment.

2. Standardized methodologies for populating the database
   - COGEU assume a realistic scenario where 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.

3. Test and certification procedures for European cognitive radios and database.

NOTHING

HIGH-SPEED INTERNET

More information just Google "**COGEU**"

2007 - 2013

CTVR