



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

“Converting unused TV channels into value for the European citizens”

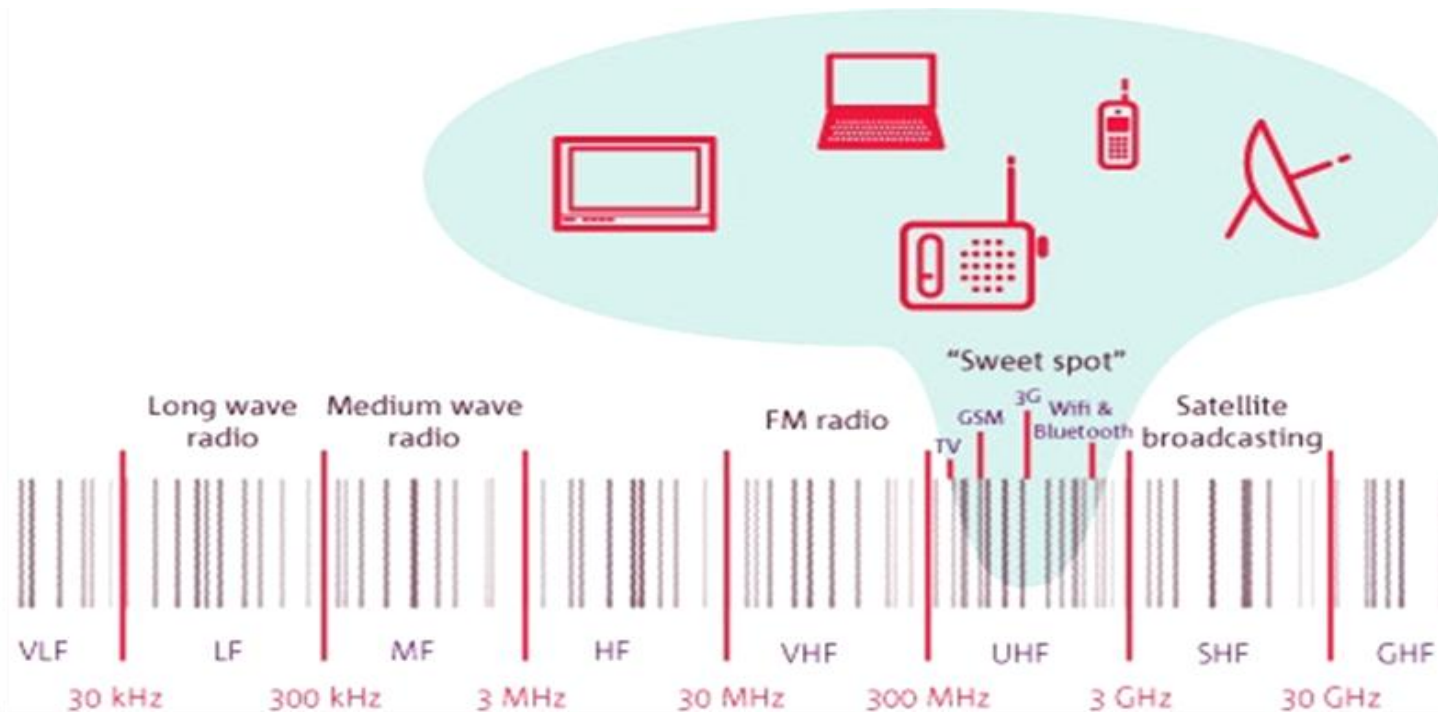
Paulo Marques and Jonathan Rodriguez

Instituto de Telecomunicações

- Project motivation
- Proposed solution
- The COGEU consortium
- Intermediate results
- 4TELL Group in FP7

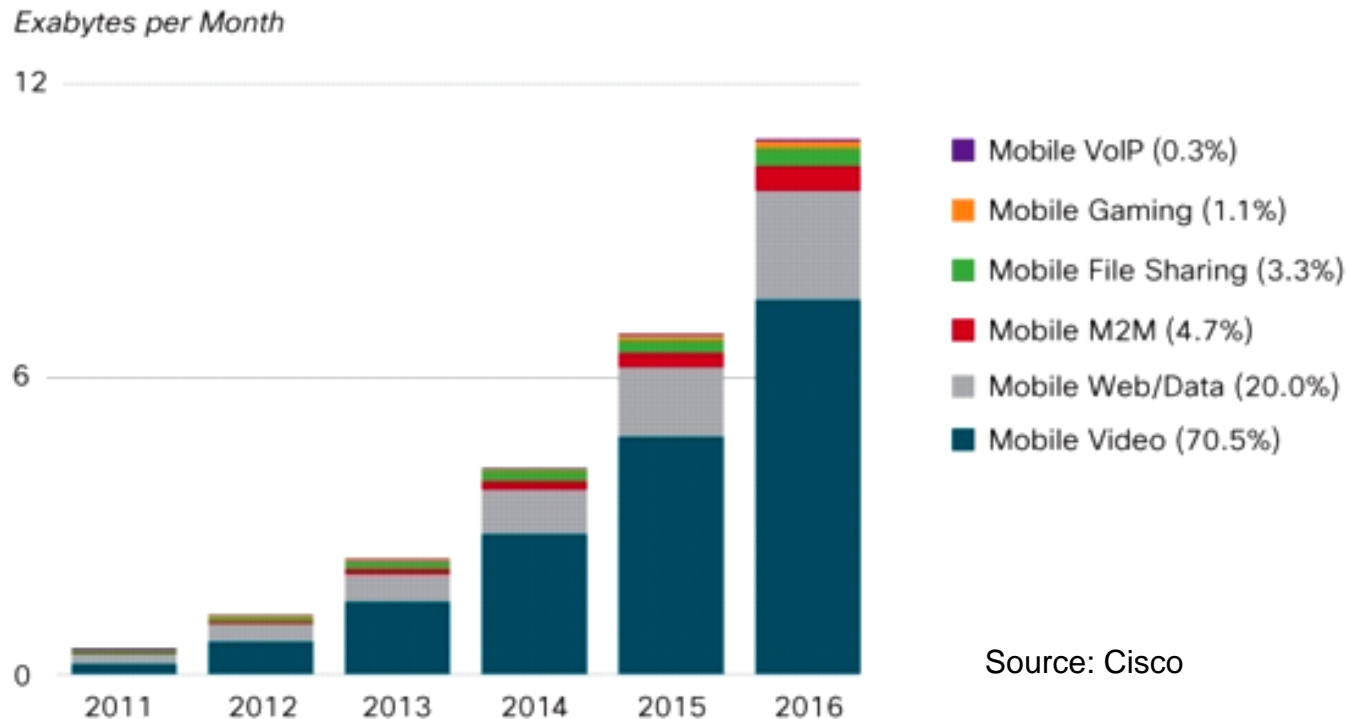
Mobile communications needs radio spectrum

- Mobile phones use radio waves to transport information.
- The radio spectrum is a limited natural resource → efficient spectrum management.
- Spectrum demand for mobile communications: **2G**: 0.2 MHz → **3G**: 5 MHz → **4G**: 20 MHz ...



Forecast grow of mobile communications traffic

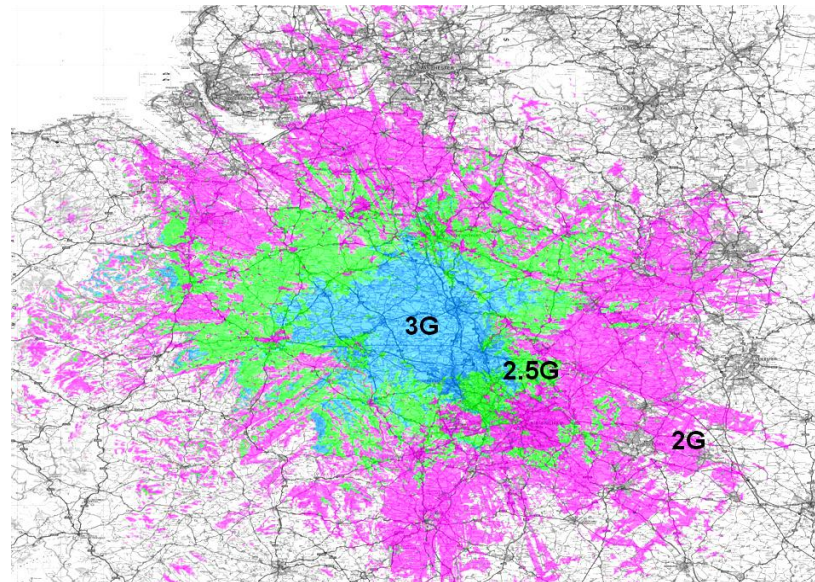
- The grow of mobile traffic will lead to a spectrum shortage in 2016 !
- Mobile video will generate much of the mobile traffic growth through 2016.
- Good spectrum is very expensive → millions of € / MHz in big auctions



Broadband for all is a political priority for Europe 2020

- The Digital Agenda for Europe set out the following objectives
 - Ensure broadband coverage of all EU citizens by 2013
 - Offer broadband coverage at 30 Mbps or more for at least half of EU households by 2020

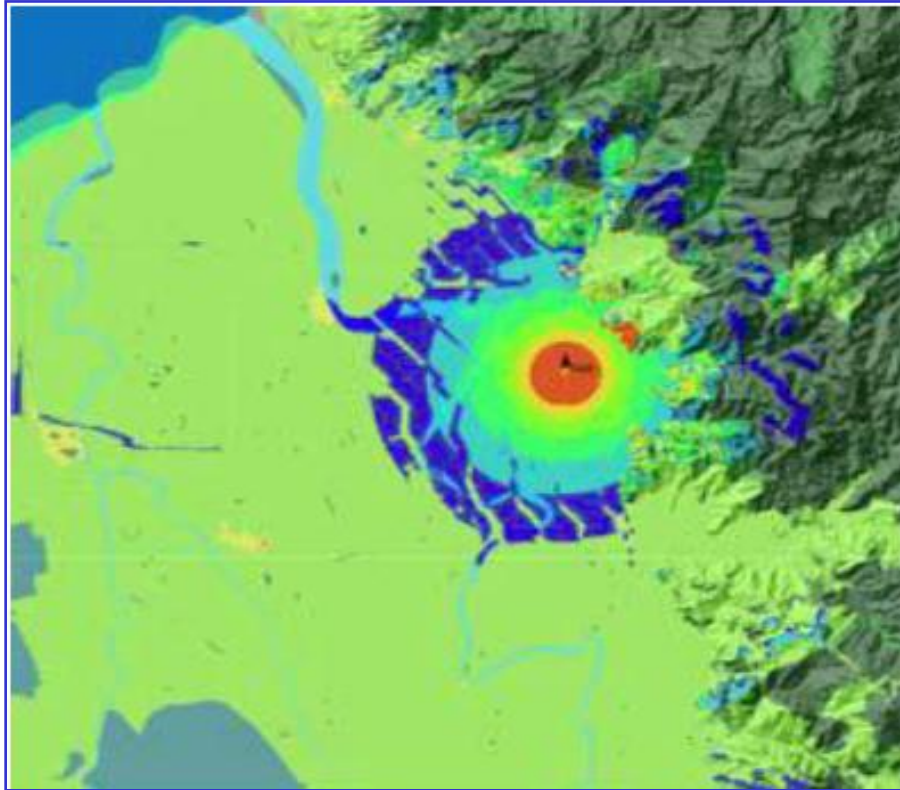
- Call of EU parliament for equal treatment of all regions within EU
 - Provide an affordable broadband internet access for rural areas



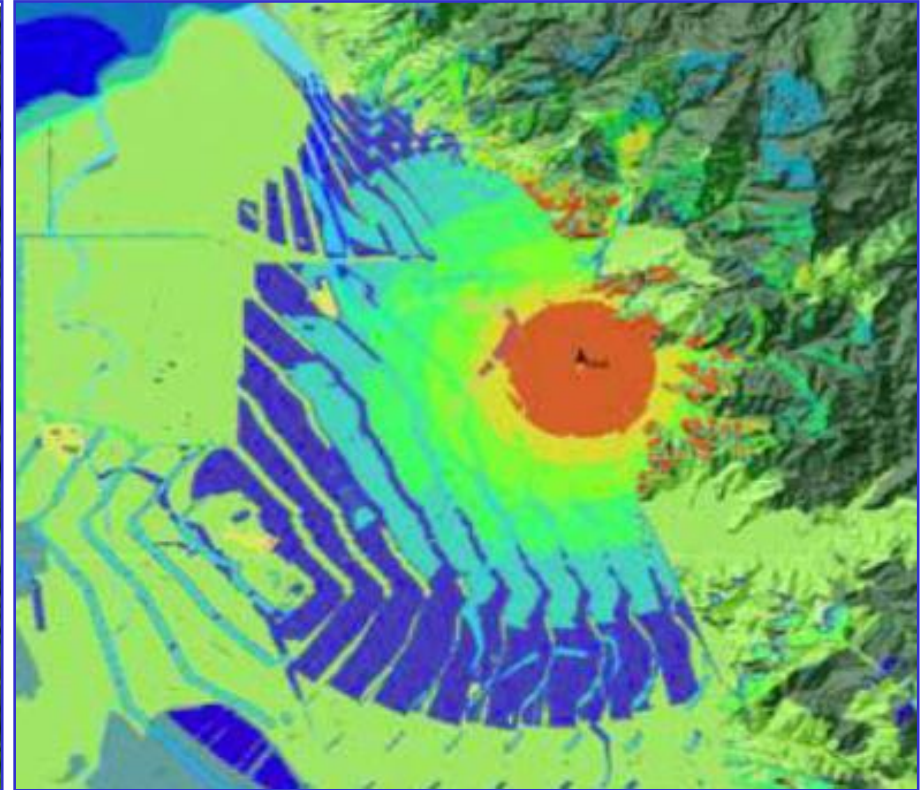
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- In Europe the complete analogue TV switch off is planned for 2012 and will open a “once in a lifetime” opportunity for the future mobile networks.
- By switching from analogue to digital transmission more television channels can be broadcast using less spectrum.
- After analogue switch off hundreds of MHz will be available between (470 MHz to 790 MHz) for new applications. This locally unused channels are called TV White Spaces.
- This spectrum has very good propagation conditions, ideal for broadband access in rural areas.

TV channels are very attractive for mobile communications



3G at 2100 MHz



3G at 600 MHz (TV channel)

The project objective

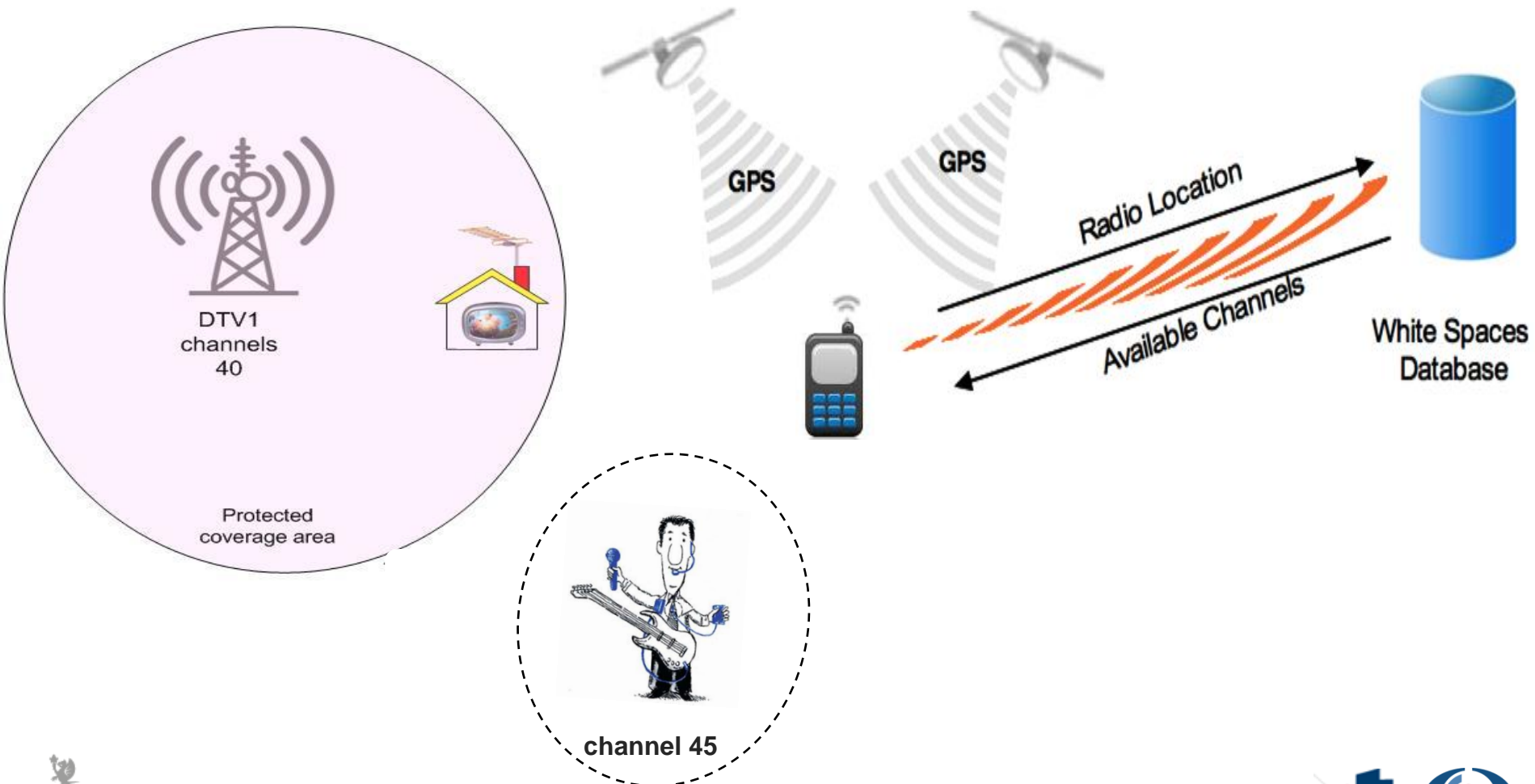
Relevant social and economic impact



- The vacant TV channels are dependant on the mobile user location.
- Guarantee no-interference with the incumbent systems: Digital TV reception and Wireless Microphones operation.
- New cognitive radio architectures and signal processing.
- Enabling spectrum policies and regulation in Europe.
- A viable business model.

The proposed solution

A simple idea



FP7 ICT Work Programme 2009-2010 Objective ICT-2009.1.1: The Network of the Future

Target Outcomes

a) Future Internet Architectures and Network Technologies

Overcoming structural limitations of the current Internet architecture arising from an increasingly larger set of applications, of devices and edge networks to be supported.

- *Novel Internet architectures and technologies* enabling dynamic, efficient and scalable support of a multiplicity of user requirements and of applications with various traffic patterns, variable end-to-end quality of service, point-to-point or point-to-multipoint distribution modes, and supporting legacy and future service architectures. The target architecture should support personalised rich media networking, machine-to-machine communication, wireless sensor networks, ad-hoc connectivity networks as well as personal and body area networks. It should also be wireless-friendly, natively support mobility, be spectrum- and energy-

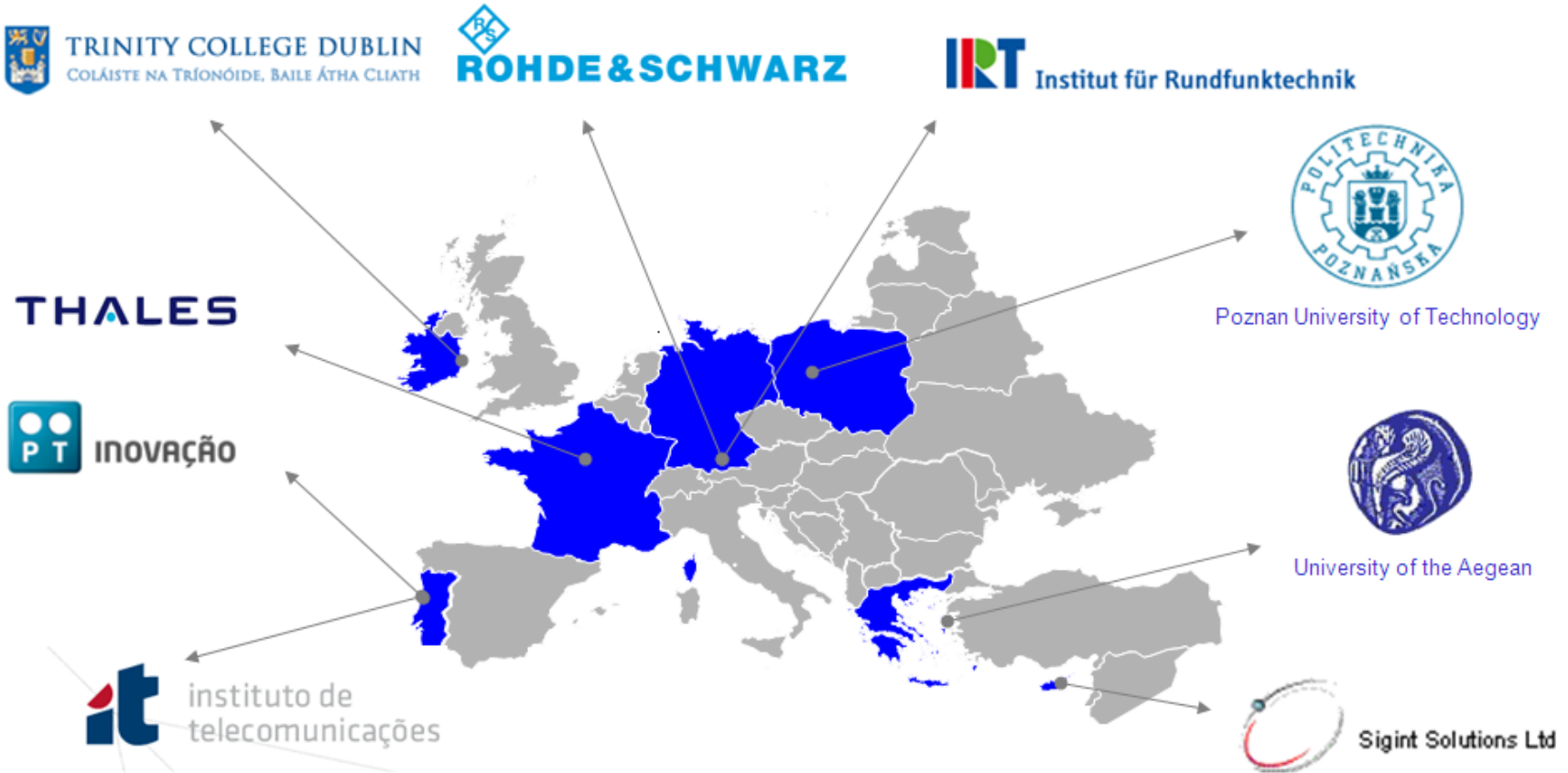
Migration paths and coexistence through overlay, federation, virtualisation and other techniques should be investigated to support several network and management architectures including legacy systems. Benchmarking capability of the proposed architecture(s) is to be considered from the onset. Clean slate or evolutionary approaches, or a mix of these, can be equally considered.

If third country partnership is felt relevant by proposers, priority should be for those third countries having established programmes in this field, notably Japan and the USA.

b) Spectrum-efficient radio access to Future Networks

- *Next-generation mobile radio technologies* that are cost-, spectrum- and energy-efficient and adapted for implementation in future high-capacity mobile radio systems. Key technology building blocks expected to be addressed are adaptive modulation and coding schemes, multiple antenna and user detection schemes, cross-layer design and low-latency transmission schemes. They are expected to be complemented by co-operative technologies at base station and/or terminal level.

The COGEU consortium



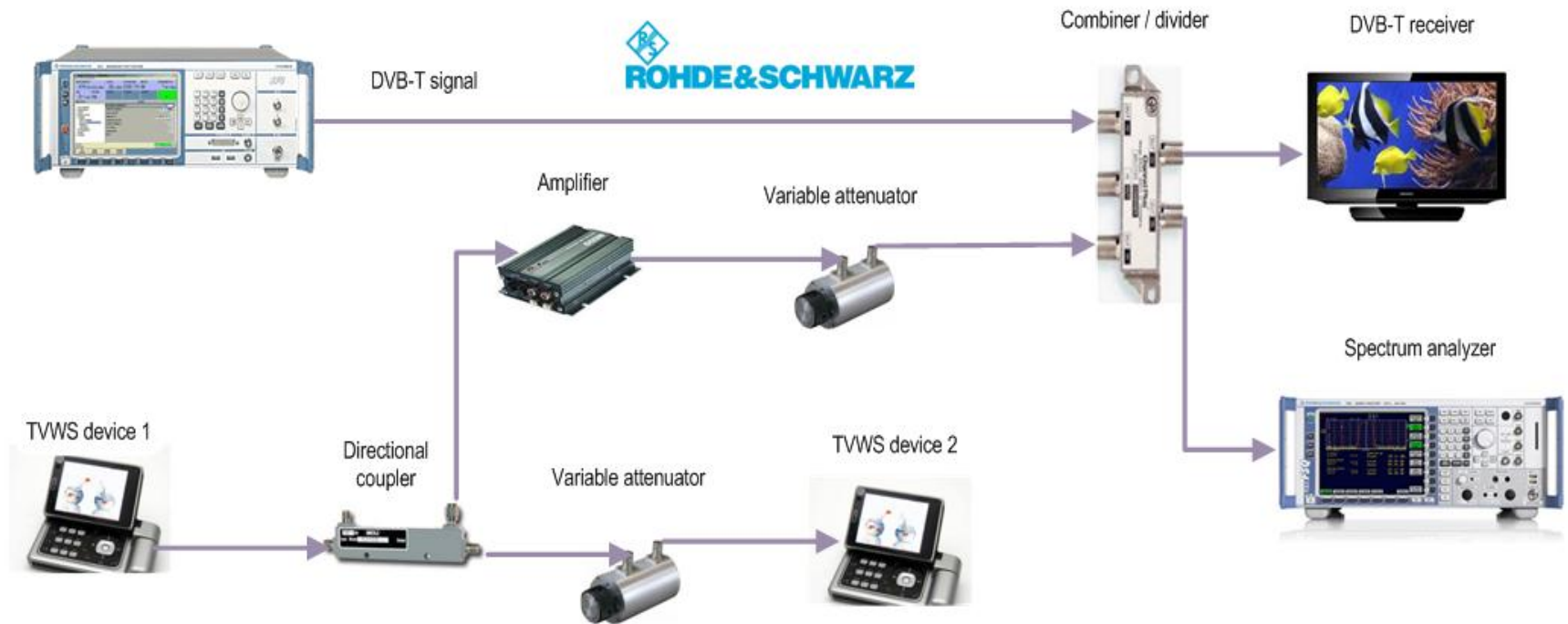
Budget Breakdown

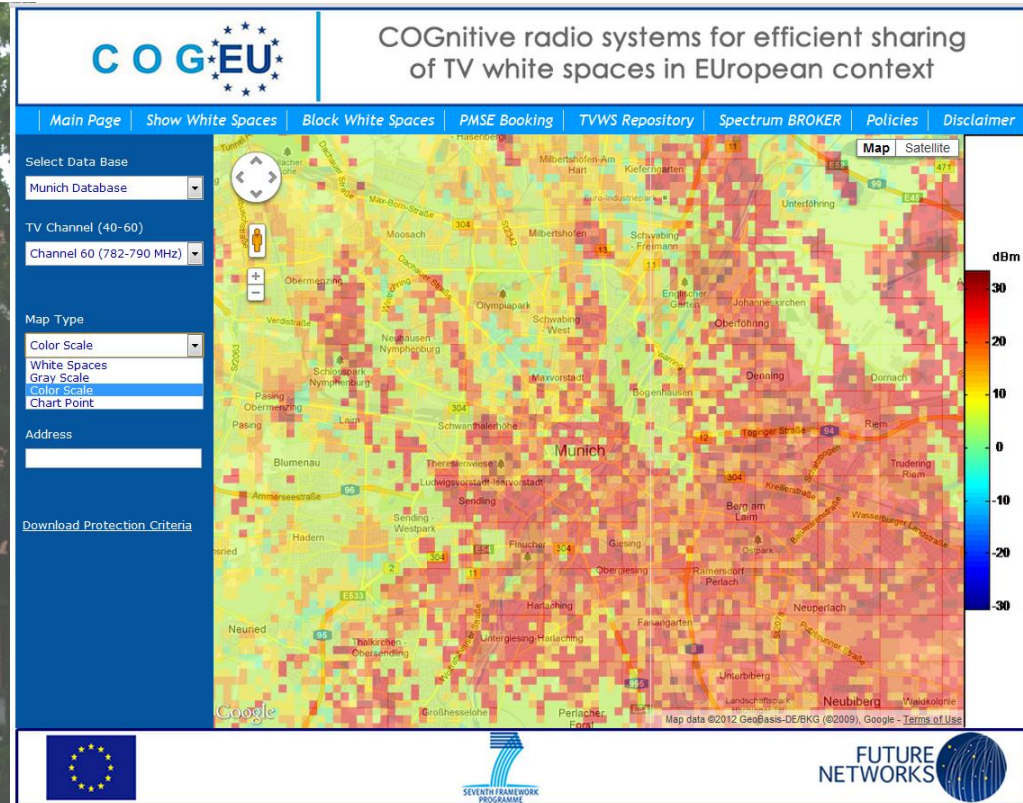
Project Number ¹	248560	Project Acronym ²	COGEU
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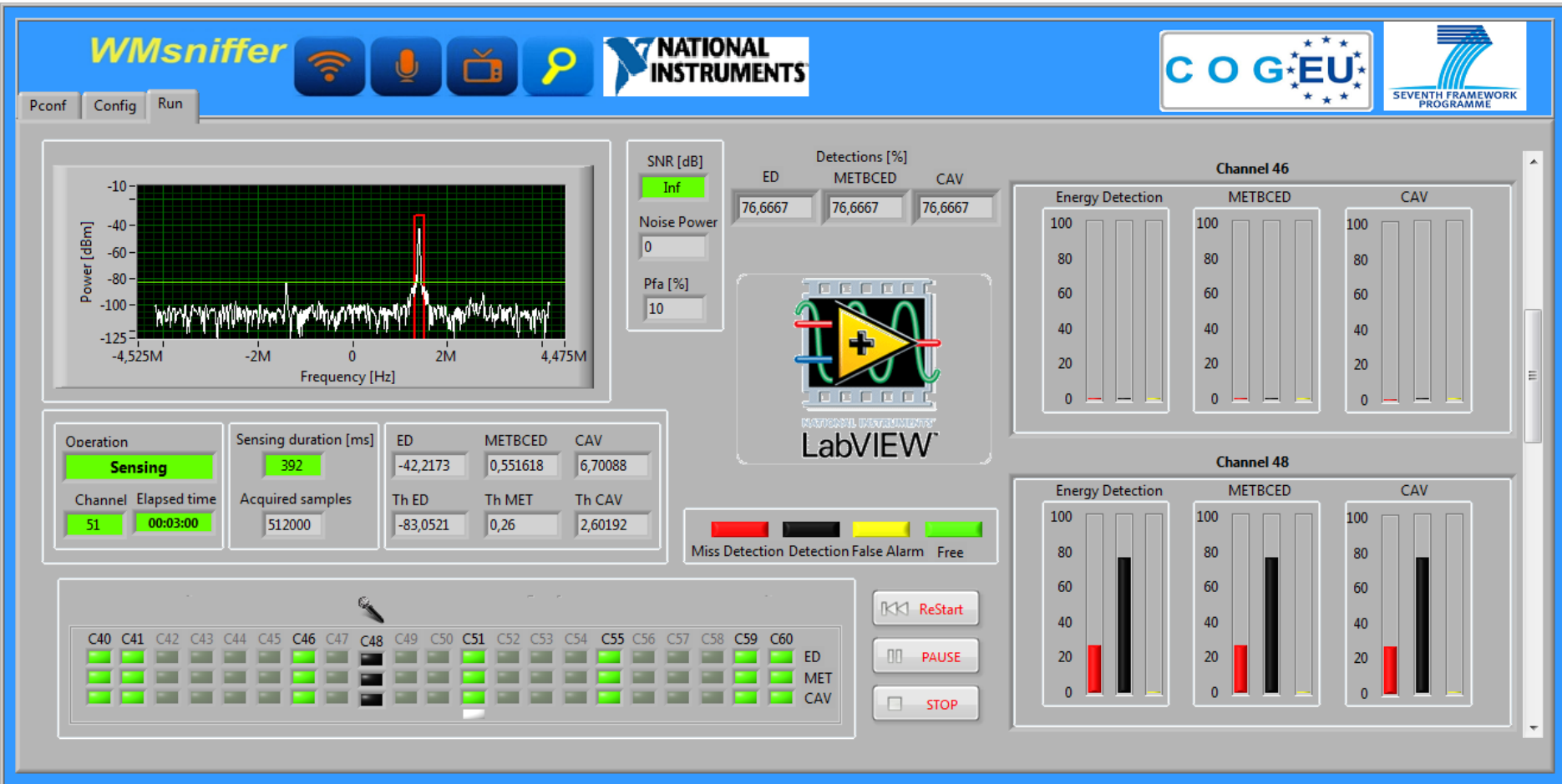
One Form per Project

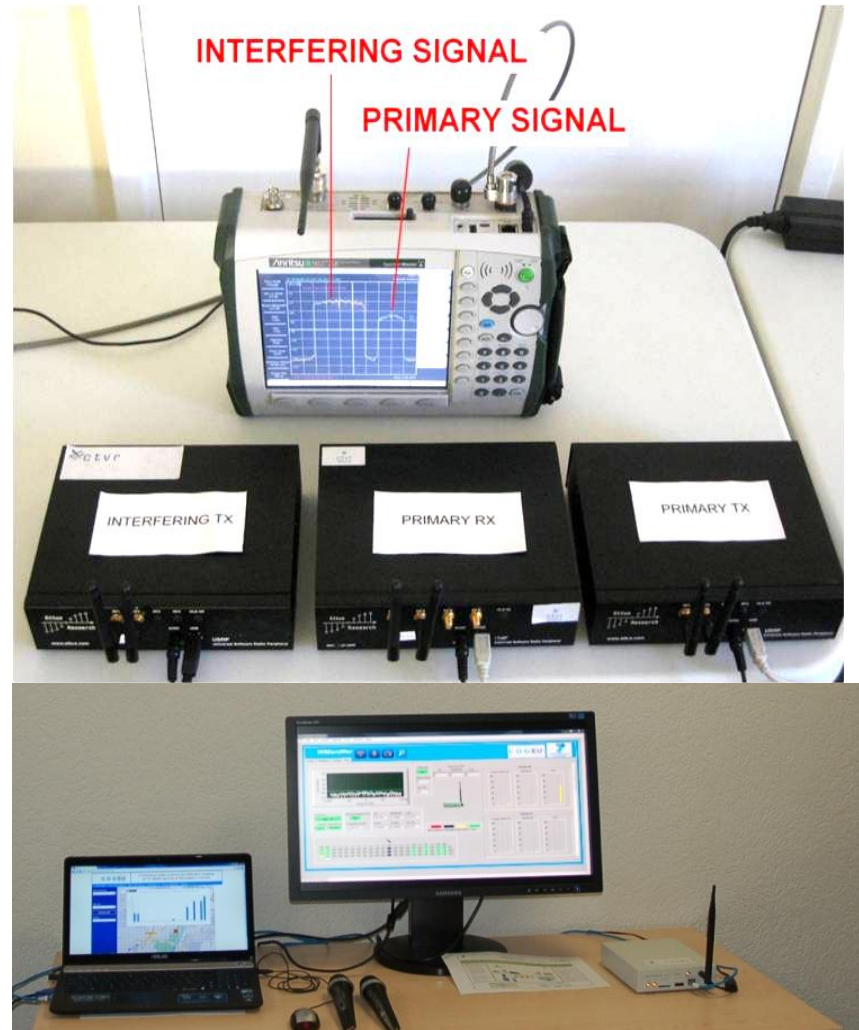
Participant number in this project ¹¹	Participant short name	Fund. % ¹²	Ind. costs ¹³	Estimated eligible costs (whole duration of the project)					Requested EU contribution
				RTD / Innovation (A)	Demonstration (B)	Management (C)	Other (D)	Total A+B+C+D	
1	IT	75.0	S	600,300.00	0.00	142,980.00	0.00	743,280.00	593,205.00
2	TRINITY COLLEGE	75.0	T	582,332.00	0.00	3,500.00	0.00	585,832.00	440,249.00
3	TC	50.0	A	749,513.00	0.00	5,500.00	0.00	755,013.00	380,256.00
4	R&S	50.0	A	720,781.00	0.00	0.00	0.00	720,781.00	360,390.00
5	PTIN	50.0	A	483,928.00	0.00	0.00	0.00	483,928.00	241,964.00
6	SIGINT	75.0	A	475,620.00	0.00	0.00	0.00	475,620.00	356,715.00
7	PUT	75.0	T	364,419.00	0.00	0.00	0.00	364,419.00	273,314.00
8	AEGEAN	75.0	T	403,699.00	0.00	0.00	0.00	403,699.00	302,774.00
9	IRT	75.0	A	711,504.00	0.00	3,000.00	0.00	714,504.00	536,628.00
10	TOWERCOM	50.0	A	325,740.00	0.00	0.00	0.00	325,740.00	162,870.00
Total				5,417,836.00	0.00	154,980.00	0.00	5,572,816.00	3,648,365.00

- COGEU got an “**Excellent**” evaluation in the 2nd Year Audit
 - Proof-of-concept prototypes of mobile radios and base stations operating in TV channels
 - Geo-location databases for spectrum
 - Trials in Munich (Germany) and Bratislava (Slovakia)
 - Recommendations to the “European Radio Spectrum Policy Program”
 - Patents and scientific publications









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Main results

COGEU in the European Parliament (1st March 2011)



21.3.2012

EN

Official Journal of the European Union

L 81/7

DECISIONS

DECISION No 243/2012/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 14 March 2012
establishing a multiannual **radio spectrum policy programme**

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SEVENTH FRAMEWORK PROGRAMME

Call: FP7-ICT-2011-8



**Cognitive Radio Standardization-initiative: from FP7 research to
global standards**

CRS-

➤ 4TELL Group Leader: **Dr. Jonathan Rodriguez** (IT-Aveiro)

➤ Coordinating:



➤ Participating:



greenet



PEACE

IP-based Emergency Application and serviCes for nExt generation networks



HURRICANE
HANDOVERS FOR UBIQUITOUS AND OPTIMAL
BROADBAND CONNECTIVITY AMONG
COOPERATIVE NETWORKING ENVIRONMENTS



ROMEO Remote Collaborative Real-Time Multimedia Experience over the Future Internet



4TELL Commandments for FP7 Project participation

- **Build a good European network** of contacts and expertise based on excellence
- **Identify the right FP7 Call** and draft your ideas, present them well in advance to the key players.
 - If you want to perform sky blue research → go for FETs.
 - If you want short-term, product orientated research → go for CELTIC/ENIAC.
 - STREPS, IPs → Mid-term research (require right flavour of innovation, but product orientated).
- **Be brave and write your own proposal** (a good one can take up to 6 months to be written).
 - Everyone can do it! Need strong good scenarios to fit around your scientific solutions.
 - Scenarios must be innovative, and promising in terms of future market exploitation.
 - Avoid “academic exercises”.
 - Industrial players and innovative SMEs required to secure project impact.
 - Some industrial players are very selective (50% funding).

- The EC will have 4 or 5 excellent project proposals targeting the same objective, so at the end it is the “**quality of the consortium**” that matters.
- A winning proposal is one that can convince the evaluator that there is life after turning 3 years old.
- As a Project Coordinator **be prepared to work** more than other partners but open doors for your group.
- **Strong leadership and diplomacy is required**, with ten partners it is not easy to pull everyone in the same direction → risk fragmentation.
- FP7 Call 10 and Call 11 before Horizon 2020

Thanks !

pmarques@av.it.pt

jonathan@av.it.pt