Trial Environment for Cognitive Radio and Networks, TRIAL Programme

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Tekes and Trial program

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Tekes – the Finnish Funding Agency for Technology and Innovation

- Tekes is the main public funding organisation for research, development and innovation in Finland
- Tekes funds both industrial projects and research projects in research organisations
- In 2011 Tekes made funding decisions regarding 1,928 projects, which resulted in 610 million euros
- About 25 % of funding is directed via Tekes programmes
- The programmes target strategically important areas of R&D that Tekes has identified together with the business sector and researchers
- Tekes programmes are forums for the exchange of information and networking between businesses and research groups
- The programmes serve as excellent frameworks for international co-operation

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Trial Environment for Cognitive Radio and Networks, TRIAL Programme

Programme duration is four years, 2011-2014

Objectives of the programme

- Finland is at global top level in the research and development of cognitive radio and networks
- Finnish companies utilise the business potential of the cognitive radio and networks
- National and international co-operation
- Finland is a temptating trial environment for foreign companies

The core of the programme is to:
”*start the trial environment for cognitive radio and networks*”

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Trial programme's focus areas:

- Efficient and flexible usage of radio spectrum
- Co-existence of radio systems
- Spectrum access and sensing technologies
- Cognitive radio geolocation database
- Smart antennas
- Interference management
- TV white space systems and applications
- Techno-economic framework of cognitive radio
- New applications and business models
- Test methodologies and test equipment technologies
- Regulation and standardization

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Key partners in Trial programme

- Trial offers international partners an opportunity to cooperate with the key players in Finland
- Research partners: Aalto University, VTT Technical Research Centre of Finland, Oulu University (Centre for Wireless Communications), Tampere University of Technology, Turku University of Applied Sciences, University of Turku, Central Ostrobothnia University of Applied Sciencies (CENTRIA Research and Development)
- Industrial partners: Nokia, Nokia Siemens Networks, Renesas, Elektrobit, Exfo NetHawk, Digita, local operator PPO Yhtiöt, Pehutec, Fairspectrum
- Public sector partners: the Finnish Defence Forces, Finnish Communications Regulatory Authority (FICORA) and Tekes

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Funding in TRIAL Programme 2011-2014

- Total volume of the programme is about 30 M€
- The volume consists of industrial and Tekes funding, and research organizations' self-financing
- Tekes funds both research and industrial projects
- National and international co-operation is respected

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Items of Interest Internationally

- Respective trial environments and laboratory facilities in other countries
- Research groups on the field of cognitive radio and networks
- Possibilities for matching research funding for collaborative projects
- Discussion of novel application areas

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Highlights from Trial research projects

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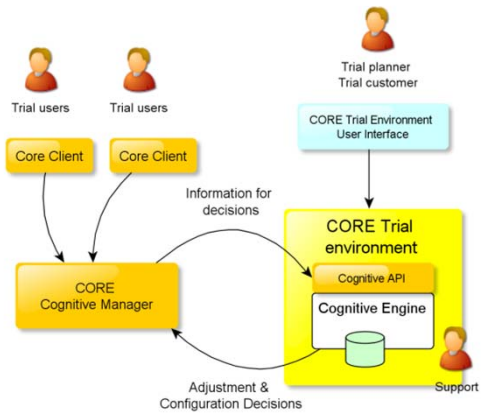
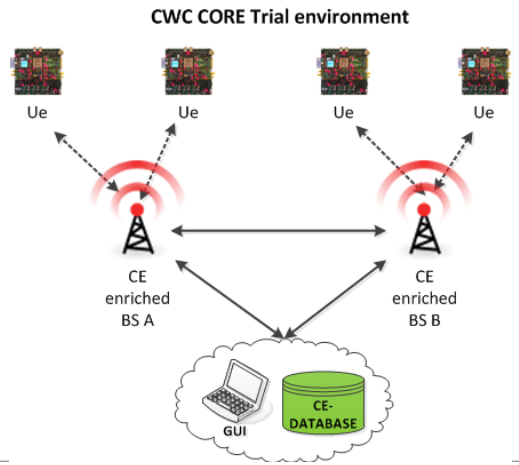
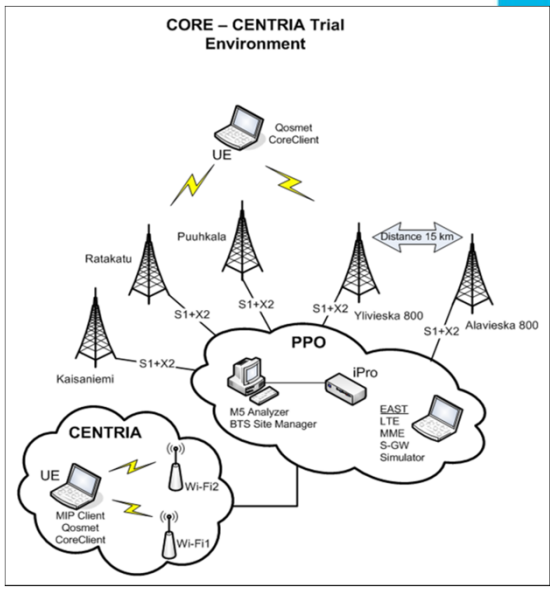
Cognitive radio trial environment (CORE)

- VTT, University of Oulu (CWC), Central Ostrobothnia University of Applied Sciences (CENTRIA)
- Development and interconnection of several CRS trial environments
- Cognitive engine (CE) design for resource optimisation in CRS networks
- Business ecosystem and business models
- Active participation in CRS regulatory activities in ITU-R WP5A
  - Contributions to ITU-R Report M.2225: Introduction to cognitive radio systems in the land mobile service. 2011.
  - Contributions to Working Document towards A Preliminary Draft New Report [LMS.CRS2] on Cognitive radio systems in the land mobile service.

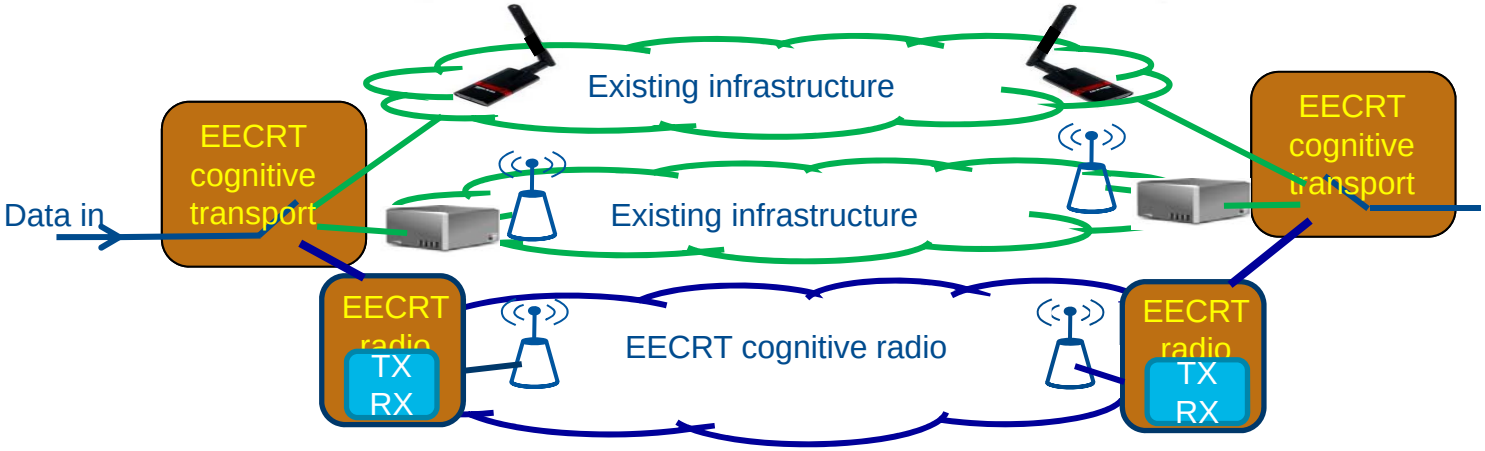






End-to-end Cognitive Radio Testbed (EECRT)

- Aalto University
- Project creates a “living lab” cognitive radio testbed for investigating
  - Dynamic Spectrum & Bandwidth Management (DSM) and Cognitive Radio Resource Management (CRRM) algorithms
  - Radio usage business models
  - Radio interface selection algorithms with the focus on end-to-end performance
  - Cognitive radio algorithms for physical layer usage



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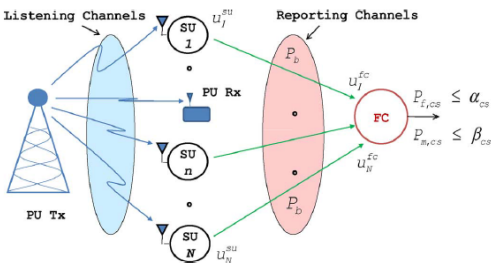
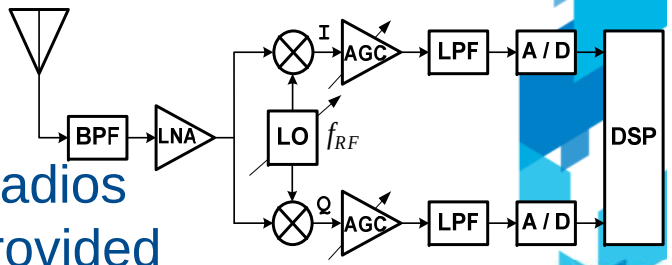
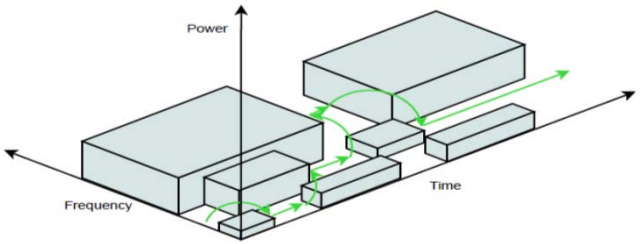
Enabling methods for dynamic spectrum access and cognitive radio (ENCOR)



- Aalto University and Tampere University of Technology
- Focus on concept design, signal processing methods and radio circuits in dynamic spectrum access and cognitive radio networks with strong demonstration emphasis.
- The goal of the project is to develop new hardware and algorithm solutions for cognitive radios and verify their functionality with test platform provided by NOKIA, in real radio environment.
- Year 2011 focus areas:
  - Spectrum exploration and exploitation methods, focus on decentralized and collaborative methods as well as wideband sensing techniques
  - Power efficient hardware implementations
  - Modeling and mitigation of hardware originated interference and nonidealities
  - Increasing the efficiency of spectrum sensor implementations with combined detectors
  - Reconfigurable building blocks for receiver chain, including wideband multiband A/D interface (TUT).





White space test environment for broadcast frequencies (WISE)

- Turku University of Applied Sciences, University of Turku and Aalto University
- Utilization of white spaces in TV frequencies (470-790 MHz) with Geolocation database
  - Development and validation of technical solutions
  - Acceleration of commercial utilization of white spaces
- Turku TV white space testbed
  - DVB test network with white space transceiver equipment and complementary computer simulation environment
  - Fairspectrum geolocation database
  - TUAS radio laboratory with possibility to perform HW simulations with test network configuration
- Active participation in CRS regulatory activities in SE43
  - 8 contributions to SE43 in 2011-2012

Trial environments showcased in Mainz 2-3 May 2012

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Cognitive Radio and Network (CORE) project
Trial Environment demo in room 1051

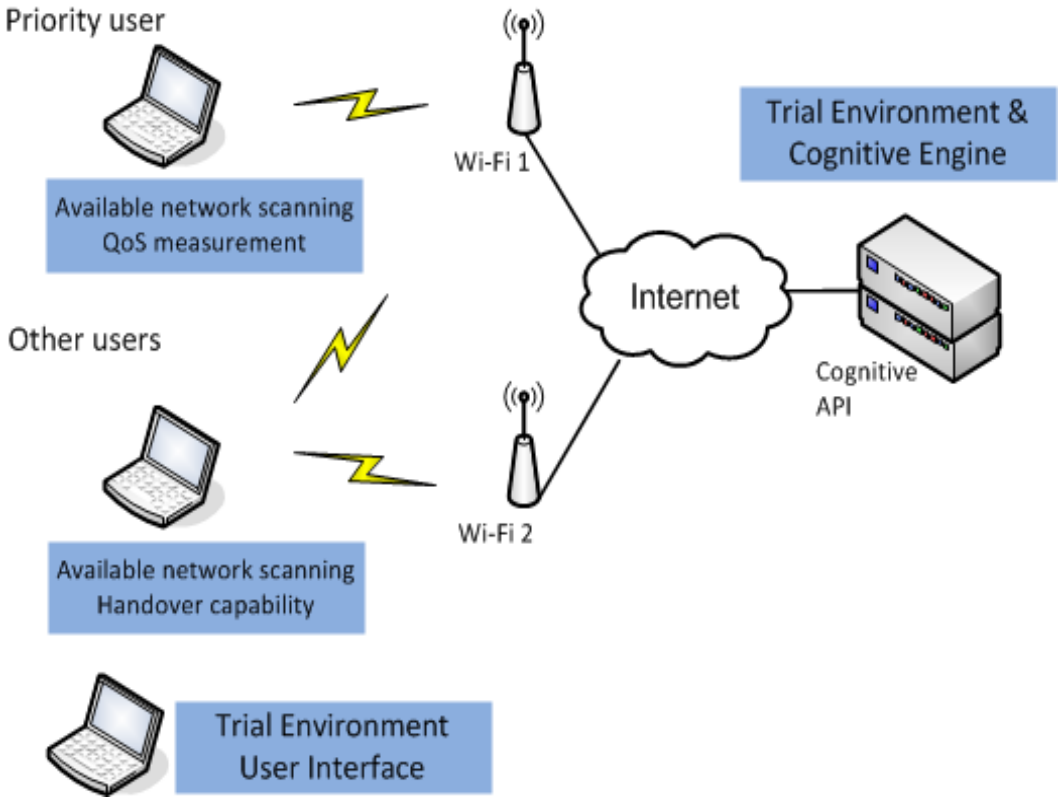
User WLAN access is prioritised using cognitive engine

Core Trial environment

- Cognitive API for data collection
- Rule-based decision making
- Publish/subscribe data delivery
- Browser-based user interface
- Remote operation

Handover decision

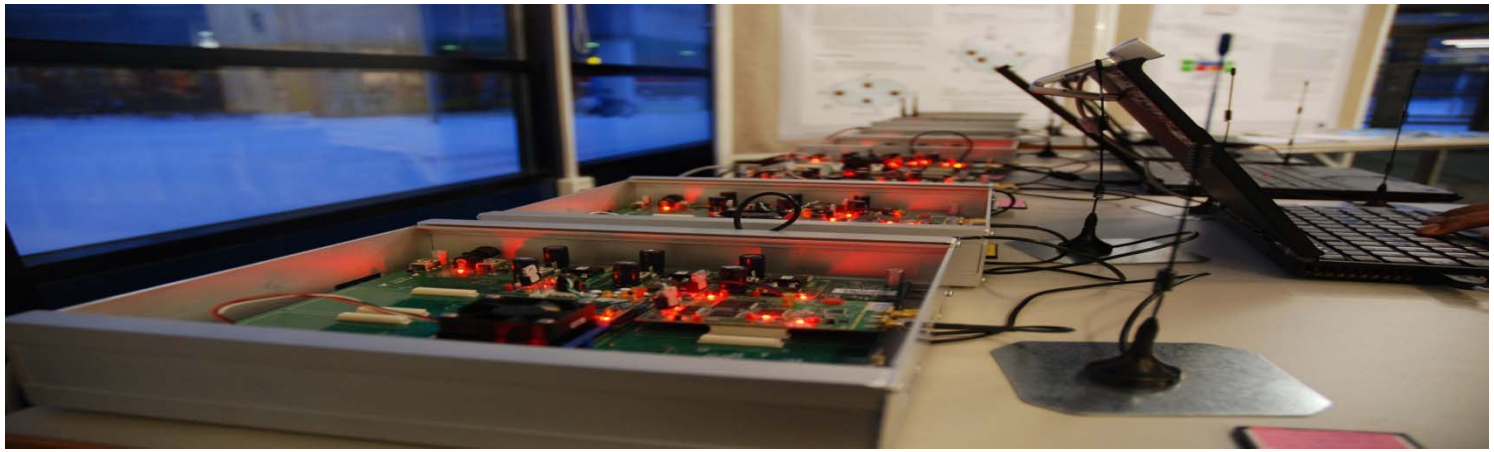
- Network availability data
- QoS measurement data



Welcome to see CORE trial demos in room 1051

CWC CORE Trial environment

- Platform to test and demonstrate cognitivity related solutions
- Centralized database to keep track of resources available in the trial network
- Load balancing algorithm functioning in trial network



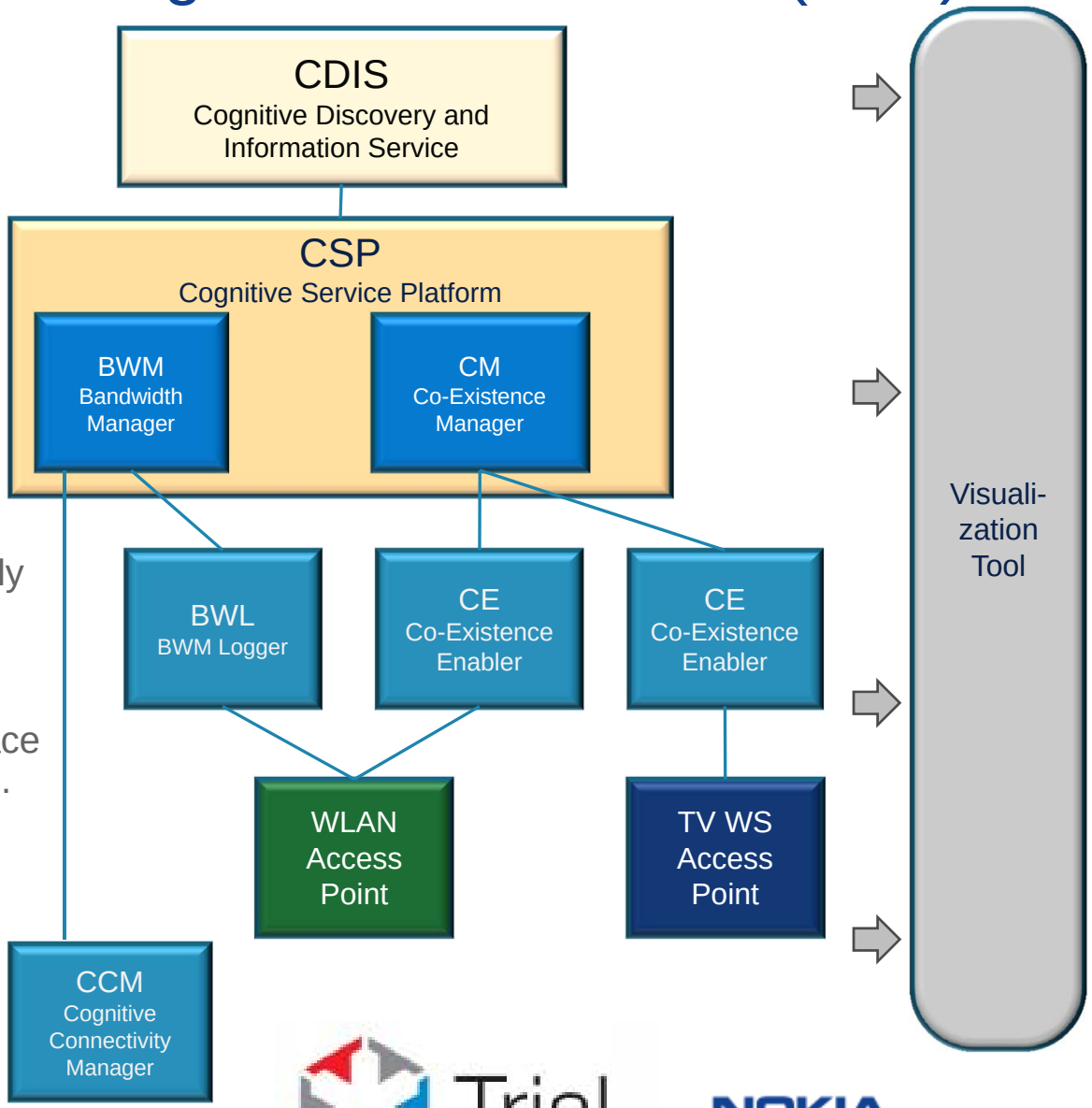
Welcome to visit Fairspectrum demos in room 1051

- Geolocation database
- White Space Device test client
- TV Data for radio microphone users
- PMSE Manager

Welcome to see Nokia's Cognitive Radio Testbed (CRT)

Main features:

- Co-existence service of heterogeneous radio access technologies along the lines of ongoing IEEE802.19.1 standardization.
- Bandwidth Manager service collecting information about available bandwidths
- Support for TV White Space
  - Integration of a commercially available industrial TV WS radio to the testbed
  - Next implementing an experimental TV White Space radio based on IEEE802.11.
- Building TV White Space test network in Otaniemi campus, Espoo, Finland.
- Visualization of the status and operation of the testbed.



Trial

NOKIA Connecting People NOKIA

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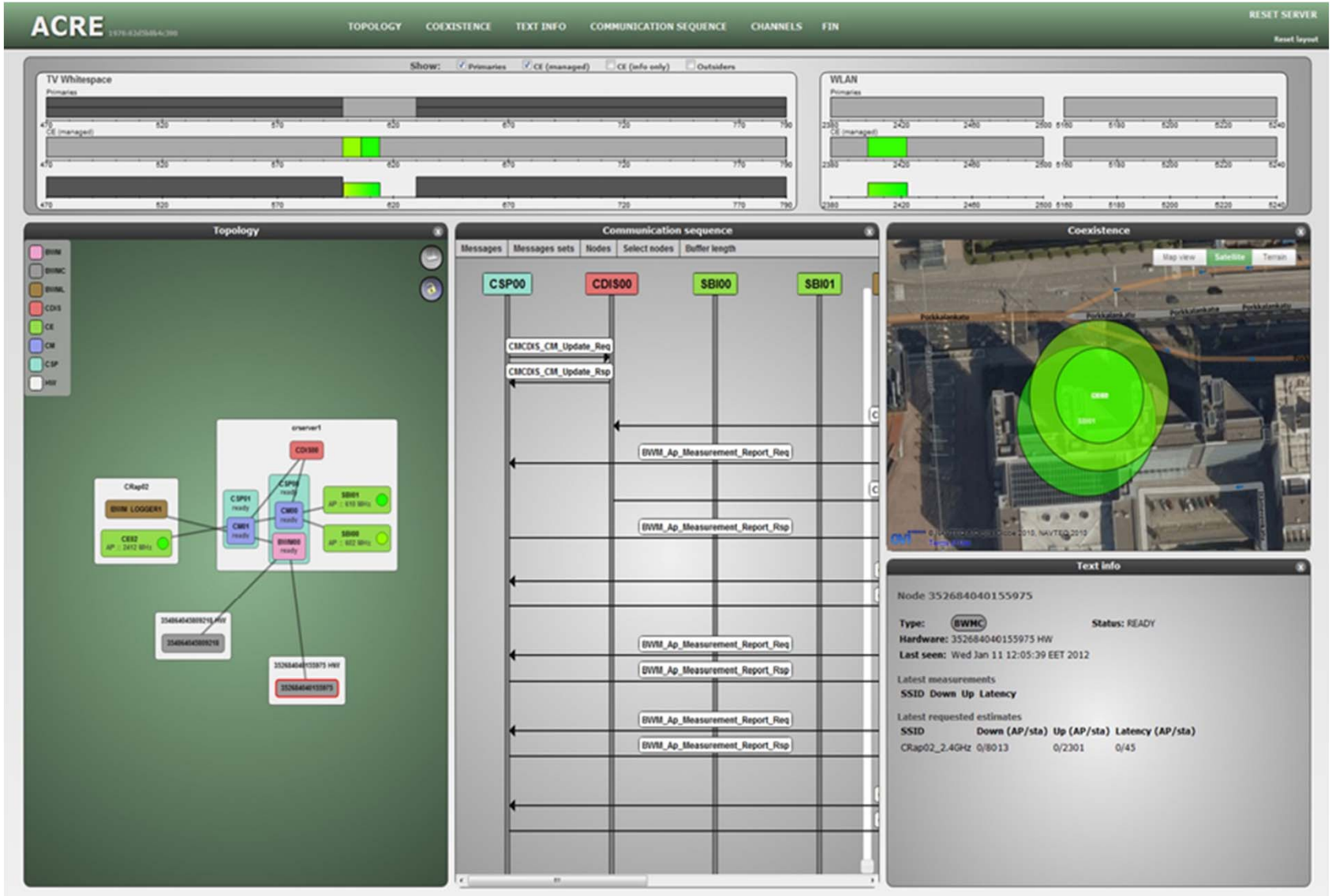
Visualization tool for CRT testbed



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Conclusions

- CRS research has reached the point where the trialing of the developed techniques is needed to showcase the function of the techniques and to quantify the benefits

- There is strong industry interest in the development of CRS techniques to facilitate spectrum sharing
  - How to make use of the developed CRS techniques in practical wireless systems such as the mobile communication systems?
  - How to create new business opportunities based on CRS techniques?

- Trial program aims at helping CRS regulation by providing empirical research results to aid in decision making
  - Showcasing of different spectrum access and sharing techniques in real-life trials using practical radio access techniques
  - Trying to identify the most promising application areas and business models

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Thank you!

More information:
http://www.tekes.fi/programmes/Trial

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