

Dynamic TV White Spaces database: practical implementation and trial results

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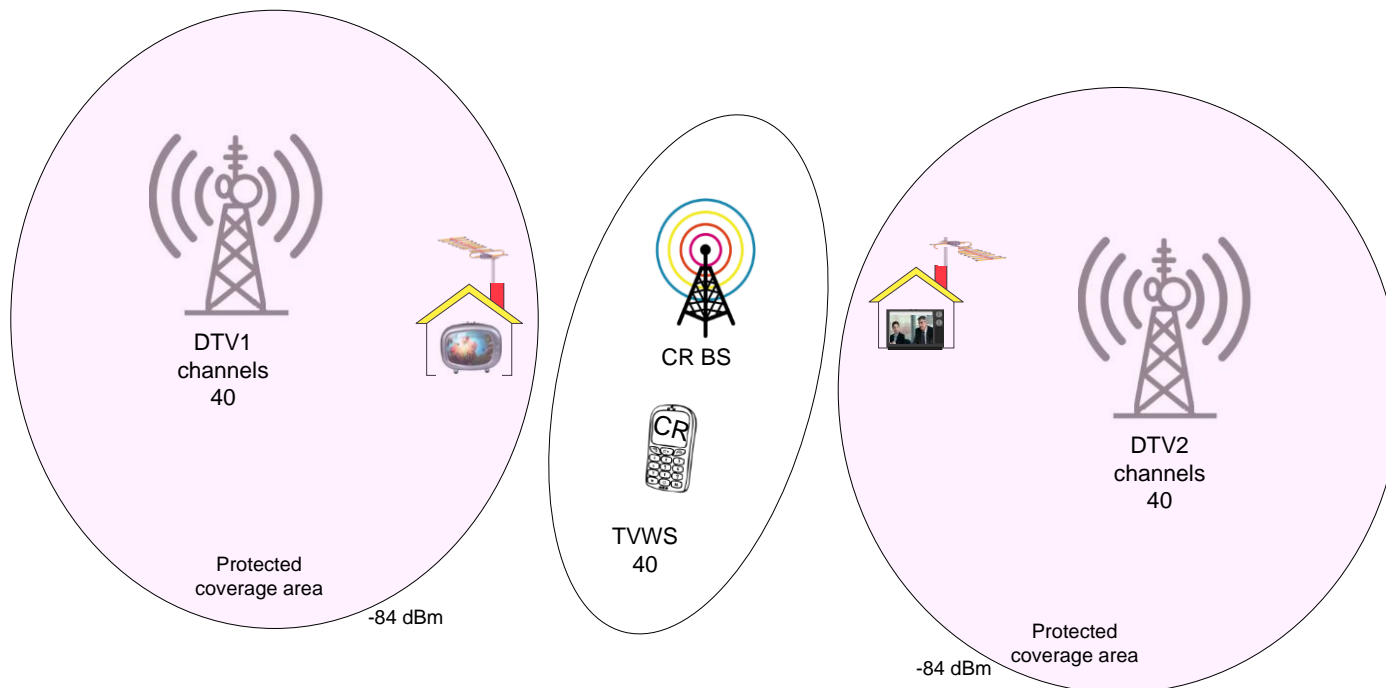
The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 258301 (CREW project) and under grant agreement n° 318563 (CRS-i project).



- **Context of the experiment**
- **Storyline of the demo**
- **Conclusions**
- **Live demo**

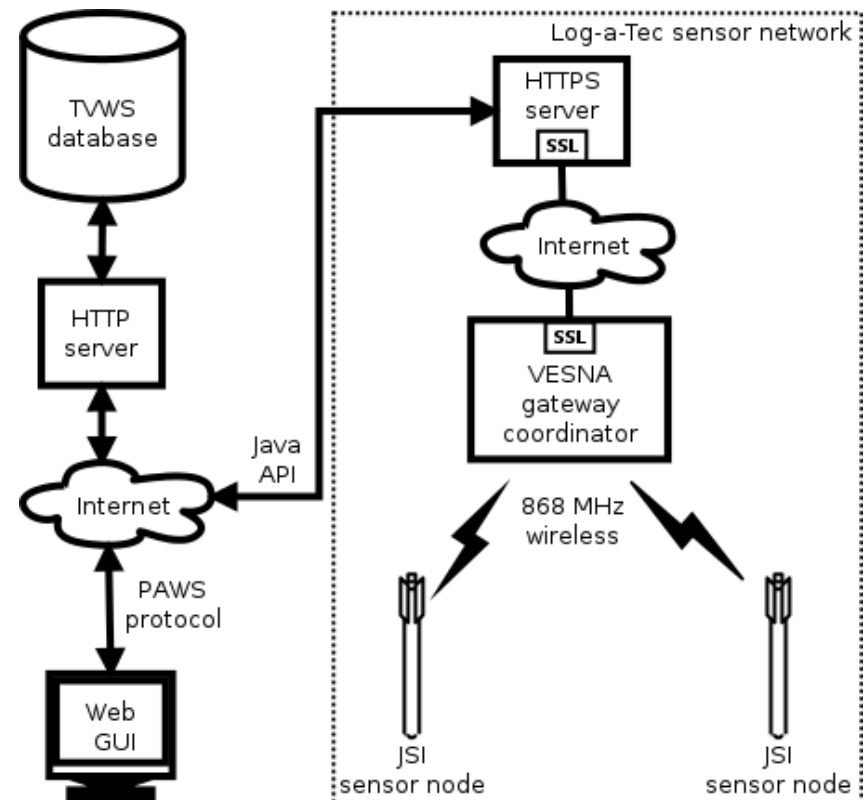
■ TVWS availability and usage

- Portions of the UHF spectrum are underutilized by DVB-T broadcasters, leaving empty channels in certain locations, called **TV White Spaces** (TVWS).
- TVWS operation by secondary users may be permitted if (and only if) it does not interfere with incumbent services such as **digital TV** and PMSEs (e.g. **Wireless Microphones**).



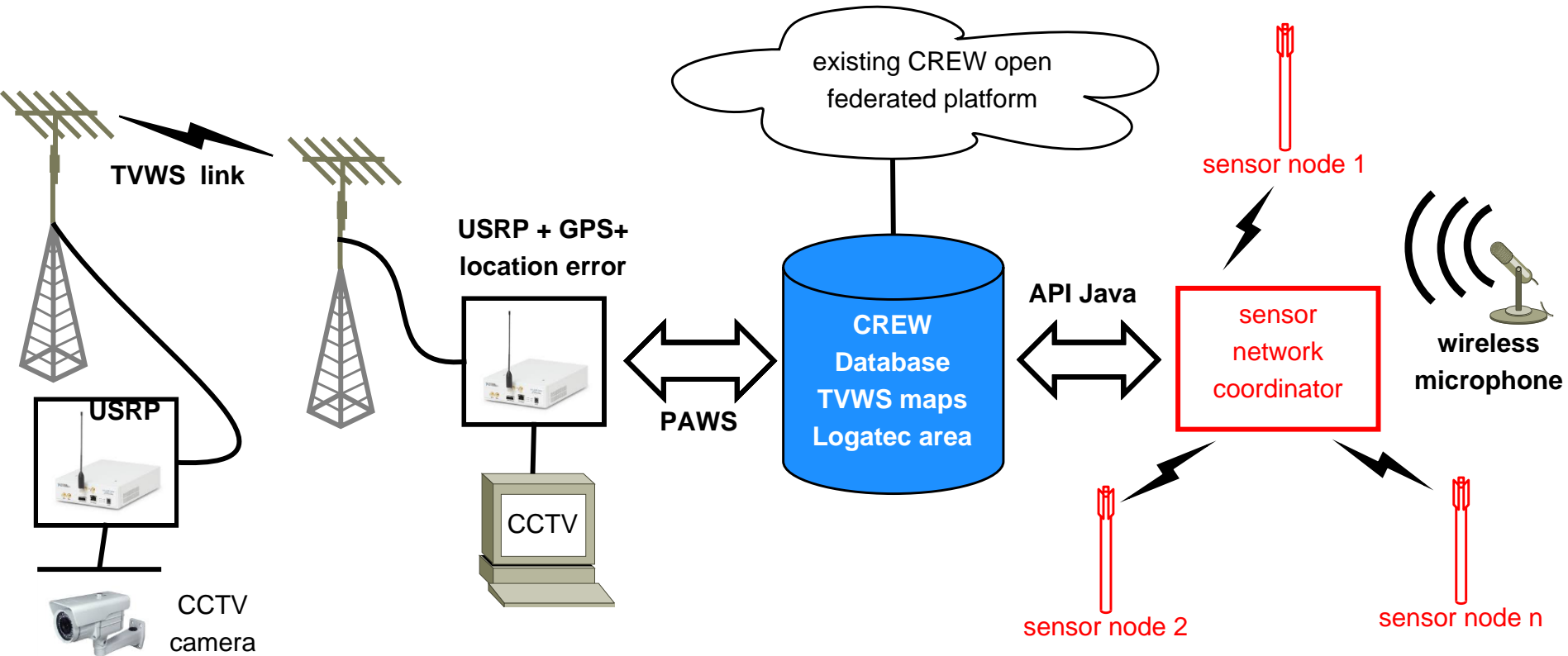
■ Short description of the experiment

- Combination of static information from a TV white spaces geo-location database with real time information from a distributed sensing network with the aim of detecting wireless microphones.



■ Which problem do we address?

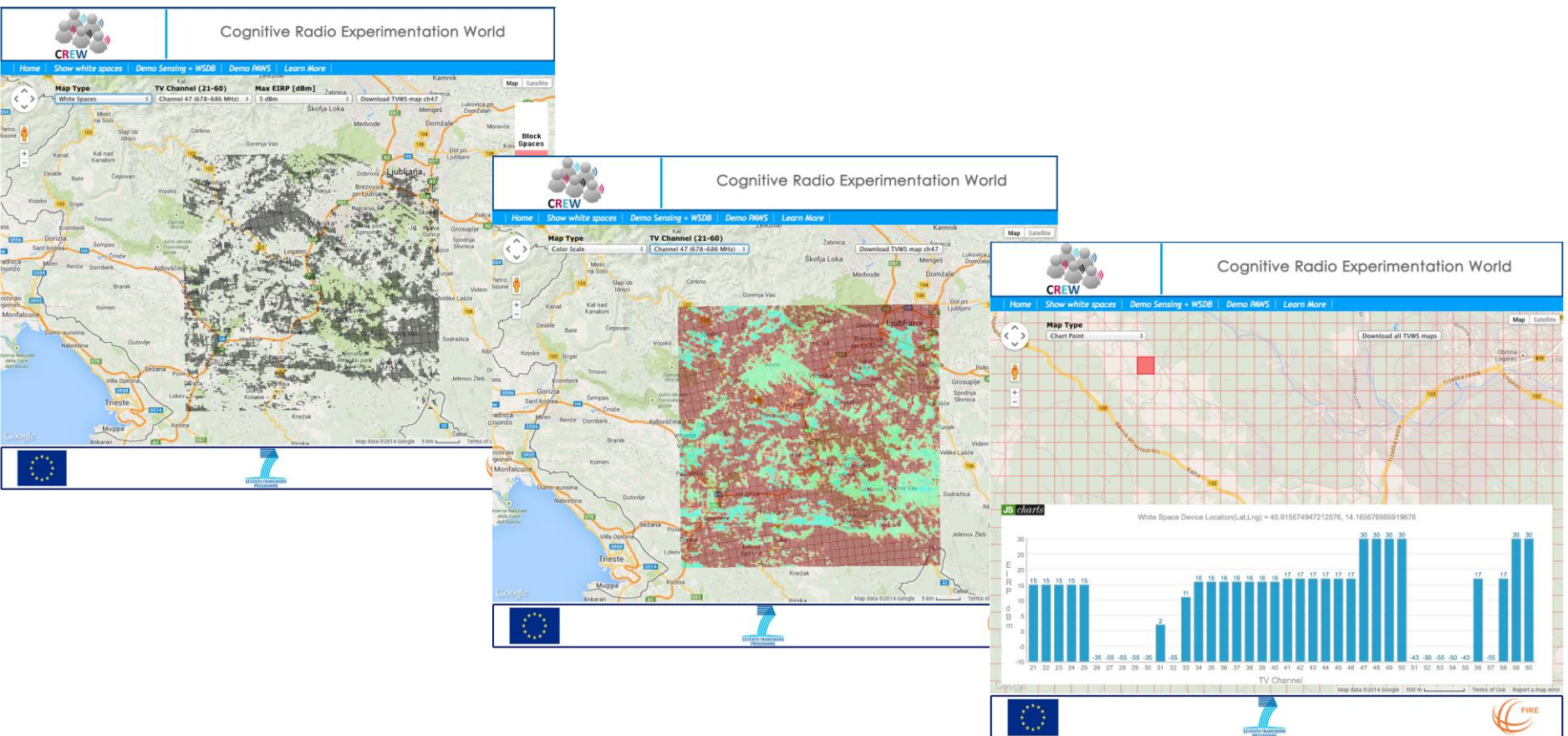
- Combination of Geo-location database access plus infrastructure spectrum monitoring is a promising approach for the effective use of TV white spaces, and the successful coexistence with dynamic incumbent systems (e.g. wireless microphones that are not registered in a database), **BUT** not yet tested in real environment.





Experimental setup

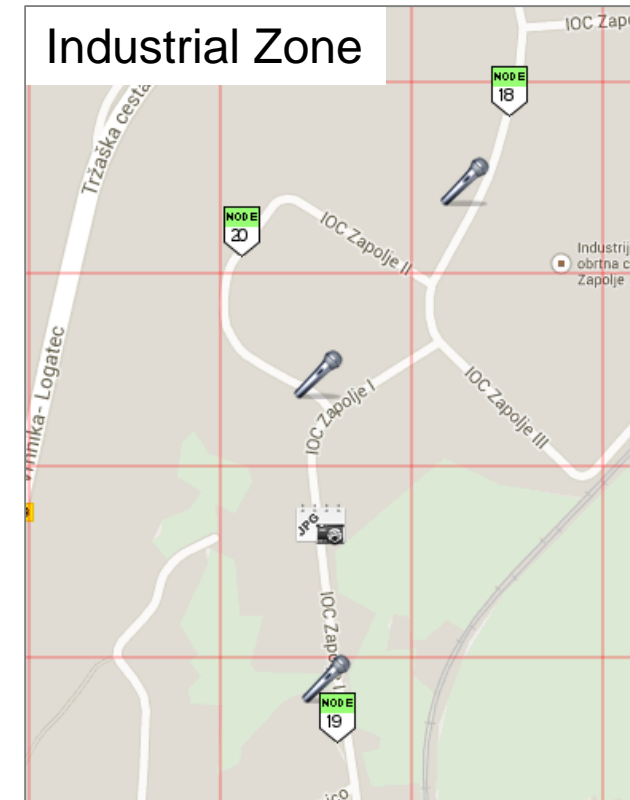
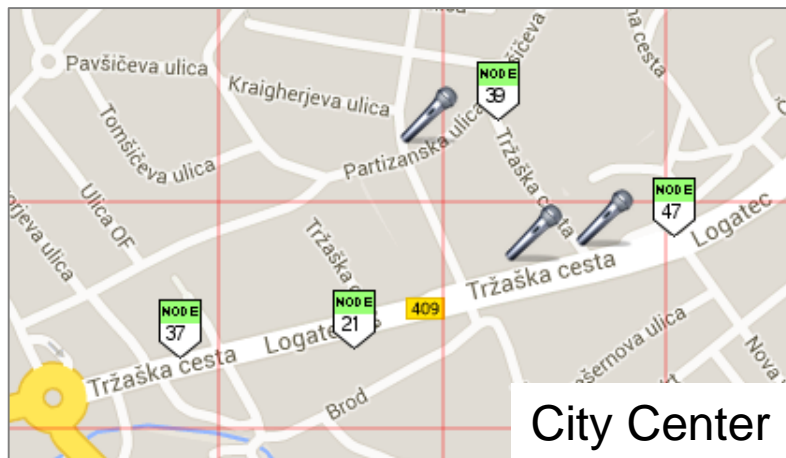
■ TVWS maps for the Logatec area (Slovenia)

- Computation based on methodology proposed by CEPT Report 186
- Several map types: White Spaces, color scale or chart point
- TVWS maps can be downloaded for further experimentation (ASCII files).



■ Remote demo set-up (JSI Testbed in Log-a-Tec)

- 6 JSI nodes configured as generators ()
 - Wireless microphone signal
 - Bandwidth: 200 kHz
 - Power: 12 dBm
 - Central frequency: from 782 to 790 MHz
- 7 JSI nodes configured as sensors ()
 - Sensing ranging from 470 to 790 MHz
 - 1.7 MHz bandwidth
 - 50 ms sensing time for each channel

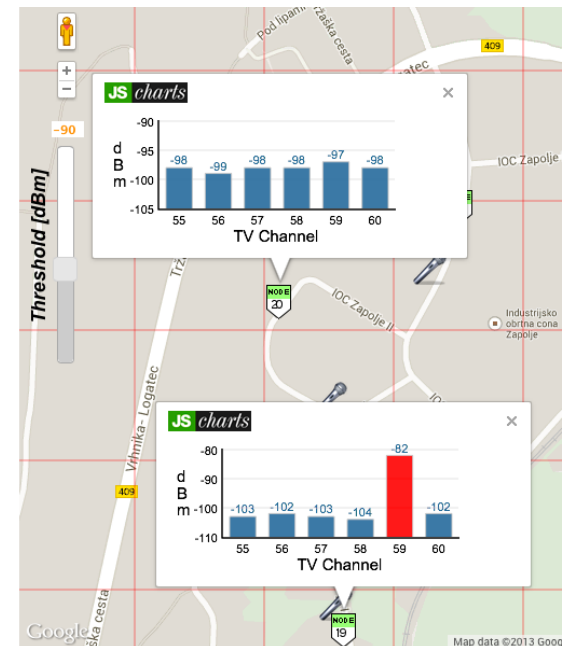
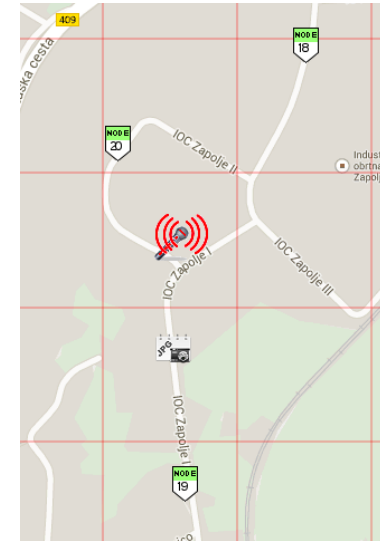


■ The user select which JSI node is the generator...

- The generator node is remotely instructed to transmit a wireless microphone signal (Java API) centered at Channel 59;

■ ... and starts the sensing process

- The sensing threshold is set by the user;
- All sensing nodes are remotely programmed to scan the spectrum in TV bands (from channel 55 to 60);
- The sensor network communicates the results to the TVWS database (Java API).
- The online Demo uses real live data or pre-measured data.



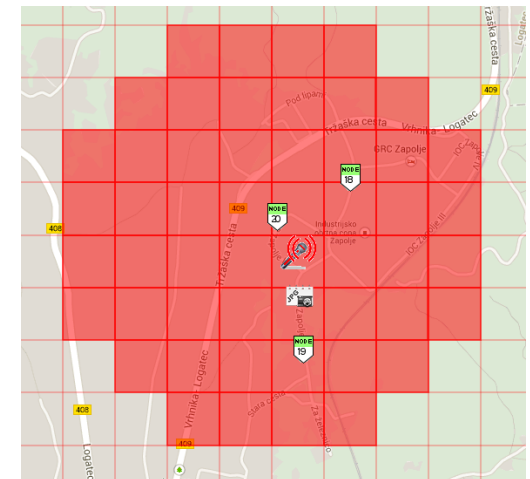
■ The geo-location database is updated...

- A **distributed sensing algorithm** combines data from spectrum sensing measurements.
- The wireless microphone channel is removed from the list of available channels.

■ ... and an exclusion area is created around the WM.

- Resolution based on TVWS geo-location data resolution (200 x 200 m grid);

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



- **The WSD queries the TVWS database for available channels**

- DVB-T channels occupied by Wireless microphone are removed from the list of available channels;
- Protocol implementation inspired on IETF PAWS;
- Web based GUI showing the message exchange between TVWS geo-location database and a WSD (laptop).

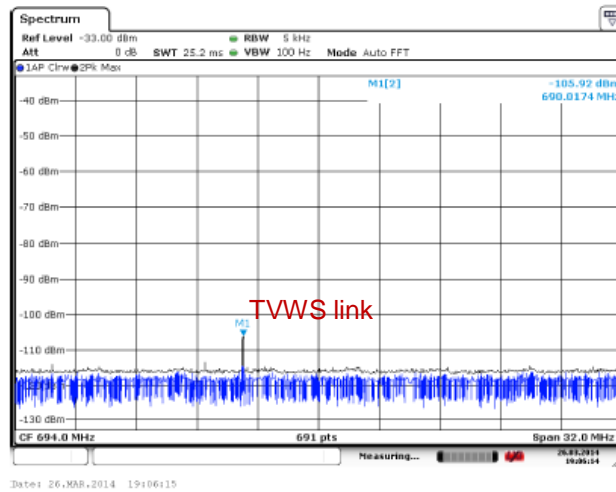
Registered TVBD ID/Serial TVBDDID23457900 - SERIAL: + TVBD ID TVBDDID23457900 TVBD Serial SERIAL34569980 Antenna Height (m) 10 Contact Country Slovenia Device Owner Owner X Device Type (1-Mode 1 Portable, 8-Fixed) 8 Latitude Show Map <input type="checkbox"/> 47.9578400673896 Longitude Show Grid <input type="checkbox"/> 11.3921501192455 Fixed Register TVBD (0) Channel List Request	TVBD Message TVBD ID = TVBDDID23457900 TVBD Serial = SERIAL34569980 Location Accuracy = 3 m <RegistrationRequest xmlns=http://www.crew-project.eu/> <AntennaHeight>10</AntennaHeight> <ContactCity>Logatec</ContactCity> <ContactCountry>Slovenia</ContactCountry> <ContactEmail>Owner_X@crew-project.eu</ContactEmail> <ContactName>Owner X</ContactName> <ContactPhone>808080080</ContactPhone> <ContactState>Slovenia</ContactState> <ContactStreet>KARDINAL</ContactStreet> <ContactZip>80798</ContactZip> <DeviceOwner>Owner X</DeviceOwner> <DeviceType>8</DeviceType> <Latitude>47.9578400673896</Latitude> <Longitude>11.3921501192455</Longitude> </RegistrationRequest> -----2----- TVBD ID = TVBDDID23457900 TVBD Serial = SERIAL34569980 Location Accuracy = 3 m <RegistrationRequest xmlns=http://www.crew-project.eu/> <AntennaHeight>10</AntennaHeight> <ContactCity>Logatec</ContactCity> <ContactCountry>Slovenia</ContactCountry> <ContactEmail>Owner_X@crew-project.eu</ContactEmail> <ContactName>Owner X</ContactName> <ContactPhone>808080080</ContactPhone>	WSDB Message Registration Process Successful!
ID Verification (Mode 1 Portable) Select a value from DB + ID Verification Request	-----1----- Registration Process Successful! Request does not match previous registration!	

■ TVWS transmission trials in Logatec (Slovenia)

- Detection of a real WM system in several scenarios (LOS, NLOS).
- In case of WM detection the database is updated and the TVWS video link (USRPs) switch from occupied channel to a new vacant channel (provided by the database).
- Protection of primary users is enhanced BUT requires a minimum deployment density of sensors 100 m x 100 m for urban areas (using energy detector).

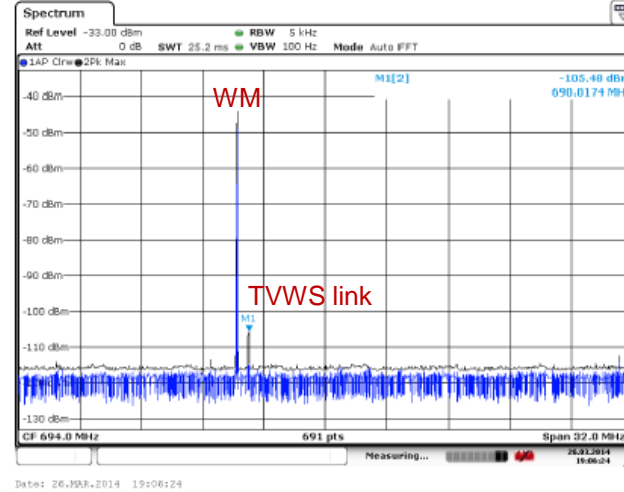


■ Spectrum measurements: switch after WM detection.



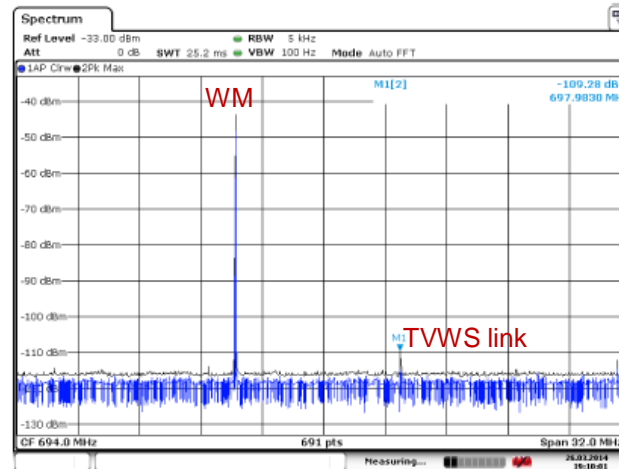
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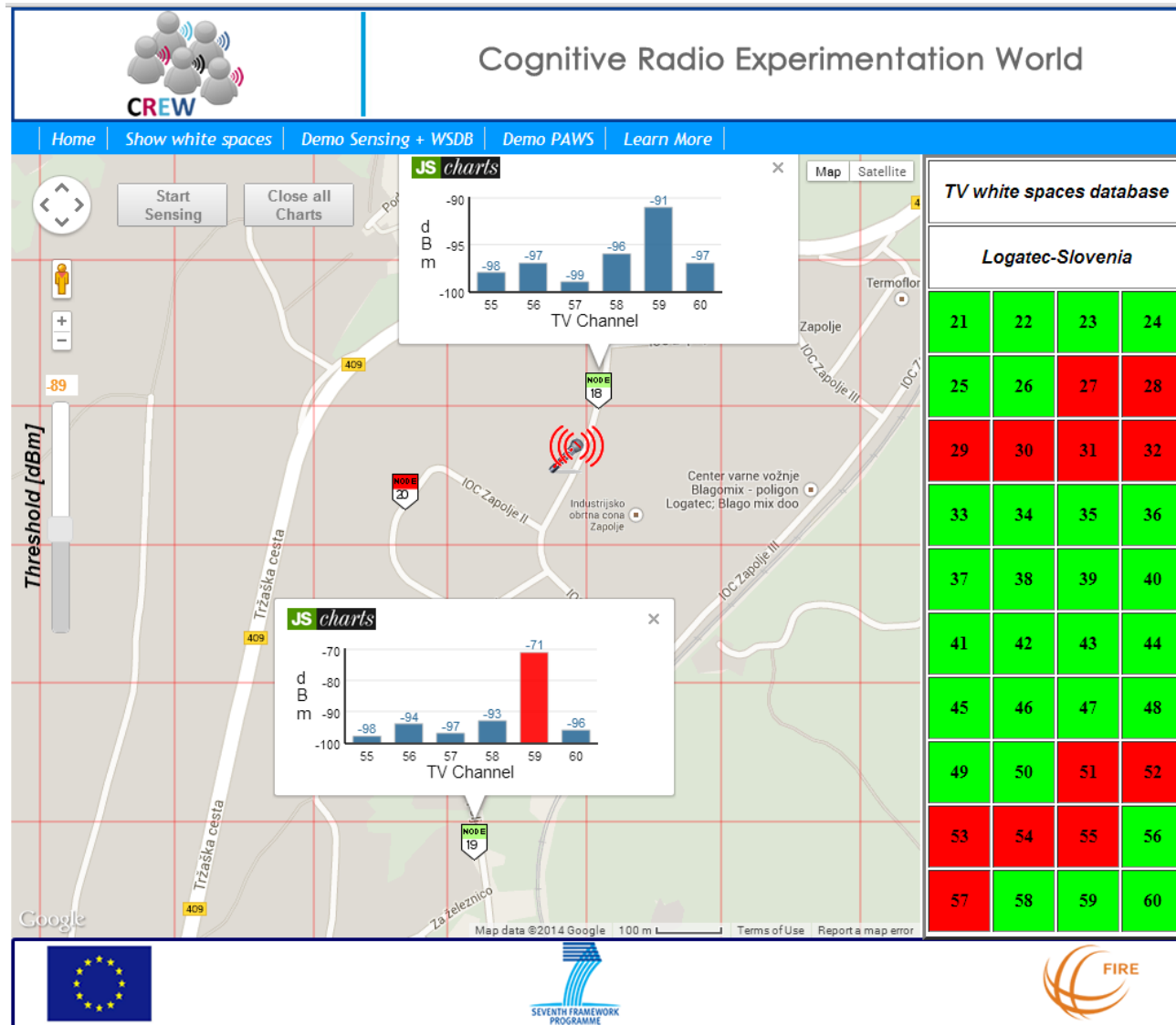
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- **Unique opportunity to experiment a new approach for combination of TVWS database with infrastructure sensing.**
- **CREW-TV experiment is key to showcase the concept helping administrations to recognize the value of spectrum monitoring as part of the progressive approach to managing spectrum more efficiently.**

■ <http://www.cmsf.eu/projects/crew-tv/index.php>



THANKS !