This demonstration highlights some of the capabilities of the OpenAirInterface platform at EURECOM. What will be shown is a software emulation of what is implemented in the hardware of the OpenAirInterface testbed. The particular topic of the demo here is Spatial Interweave, which is in some sense a multi-antenna version of Inter-cell Interference Coordination (ICIC). Whereas in the single-antenna case, one can only play with transmit powers (and time-frequency resource allocation), in the multi-antenna case one can exploit spatial (rank) gaps. The Spatial Interweave cognitive radio scenario is applicable to macro-small cell coexistence. Only the secondary units (small cell) are required to have multiple antennas. In the Spatial Interweave paradigm, the secondary link can transmit but should not cause any interference to the primary link. With multiple antennas, this can be done by transmitting while zero-forcing to the primary receiver, as in the Figure. This is fairly easy to achieve if the secondary transmitter knows the channel response from its antennas to the primary receiver. The challenge is that this cross-link channel knowledge should be acquired without any cooperation from the primary link. Two approaches are being pursued.

In the CROWN FET project, the proposed solution was to exploit channel reciprocity in TDD (Time Division Duplex), involving synchronization of the secondary link to the primary uplink/downlink ping-pong timing. Channel reciprocity allows to infer a downlink channel from the corresponding uplink (when the secondary Base Station (BS) receives the transmit signal from the primary Mobile User (MU)). However, reciprocity only applies to the actual propagation channel up to the point in the antenna cable where both transmit and receive RF chains connect. The further RF electronics up to the digital domain (ADC in receive chain, DAC in transmit chain) are not reciprocal between the RF of BS and MU units. Relative calibration has been introduced to identify the transfer functions of the various RF parts, requiring a training and feedback session between transmitter and receiver. However, the primary units will not exhibit any cooperation. But it turns out that the calibration factor at the secondary BS side can be determined by a relative calibration operation between the secondary units only, circumventing any need for cooperation from the primary units. This approach is what is shown in the actual demo.

In the WHERE2 FP7 project, another approach is being pursued, in which the location of the primary receiver gets exploited by the secondary transmitter, to allow to determine the cross-link channel by exploiting a database of such channel responses as a function of position. This database, at the secondary BS, gets filled up with data from the secondary communication, as the secondary MU is moving around.

WHERE2: http://www.kn-s.dlr.de/where2/index.php
CROWN: http://www.fp7-crown.eu/
SACRA: http://www.ict-sacra.eu/