TRAINER
Towards aRtificiAl Intelligence-based NEtwoRk optimization

UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

GRCM

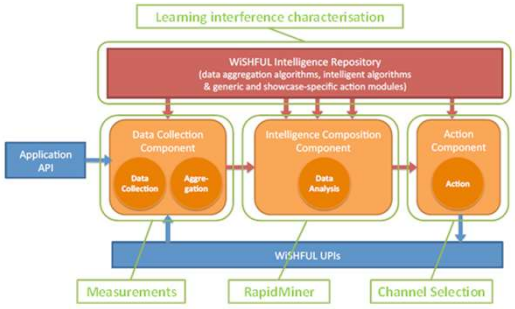
GOALS

- To extend the capabilities of the WISHFUL testbeds through the introduction of knowledge-based capabilities provided by RapidMiner Studio. This, in conjunction with the existing WiSHFUL Intelligence framework can provide a powerful experimentation environment for future networks such as 5G.
- To illustrate the use of this extension through a specific experiment using the IRIS testbed (@TCD), that focuses on the Channel Selection functionality for Cognitive Radio Networks (CRN).

CHALLENGES

- The introduction of RapidMiner in the context to the WiSHFUL Intelligence Framework.
- To carry out classification and categorization of data that can be obtained from the different WiSHFUL testbeds so that it can be processed by means of RapidMiner for knowledge discovery purposes.
- To exploit the IRIS testbed for the proof-of-concept of channel selection based on a supervised classification provided by the proposed extension. This will make use of the measurements and of the capability of configuring the operating channel of a transmitter using the WiSHFUL UPIs for Radio Control (UPI_R).

IMPLEMENTATION



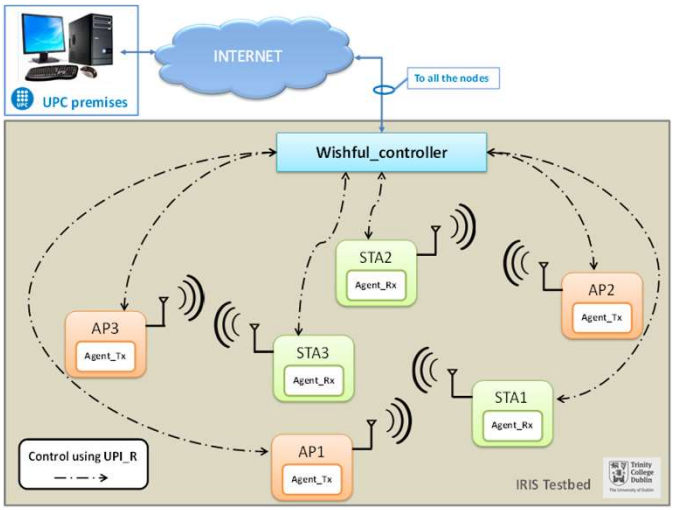
The implementation on WiSHFUL Intelligence Framework includes:

1. Data Collection Component: collect measurements (Data Collection) and average values (Aggregation).
2. WiSHFUL Intelligence Repository: data analysis to estimate the interferers with RapidMiner. This is performed through a classification using different algorithms:
   - Decision tree induction
   - Naive Bayes
   - Support Vector Machine (SVM)
   - Neural Network
3. Intelligence Composition Component: stores the learnt model.
4. Action Component: executes the channel selection decision making process using different algorithms:
   - Supervised classification-based
   - Q-learning-based
   - Game theory-based

EXPERIMENT SETUP

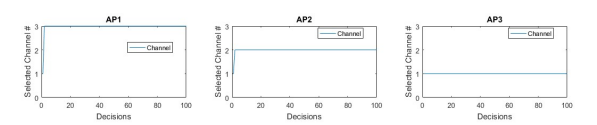
Channel Selection in Cognitive Radio Networks

- 3 transmitters (named AP1, AP2, and AP3), 3 receivers (named STA1, STA2 and STA3) and 1 controller.
- Each pair APi-STAi uses different synchronization words.
- 3 channels (Ch1:2890MHz, Ch2:2900MHz, Ch3:2910MHz).
- Initially all the AP transmit on Ch1. Subsequently they change their frequency according to the different channel selection algorithms.

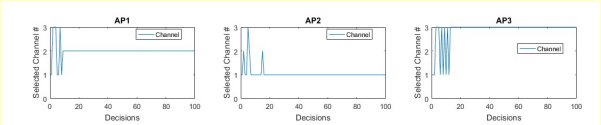


EXPERIMENT RESULTS

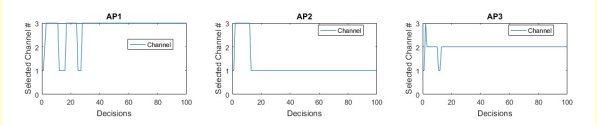
Selected channel numbers with Algorithm 1 (Classification-based) and SVM classifier for each AP



Selected channel numbers with Algorithm 2 (Q-learning) for each AP



Selected channel numbers with Algorithm 3 (Game theory) for each AP



CONCLUSIONS

- All the considered algorithms for channel selection converge to an optimum solution where all the APs operate in a different channel. However the number of decisions required before convergence differs.
- The fastest convergence is obtained with the classification-based algorithm with SVM and Naive Bayes classifiers while game theory and Q-learning based approaches exhibit slower convergence.
- The incorporation of the RapidMiner tool into WiSHFUL creates a more powerful and versatile experimentation environment for early implementation and validation of end-to-end 5G solutions.

FEEDBACK

Thanks to the software tools and hardware provided to us by WiSHFUL we were able to test different scenarios with multiple wireless transmitters and receivers and assess the performance of different channel selection algorithms exploiting knowledge discovery functionalities to characterise the interference in the environment.