WIFI-Dense: Experimental assessment of WiFi coordination strategies in dense wireless scenarios

allbesmart

Goal(s) of Experiment

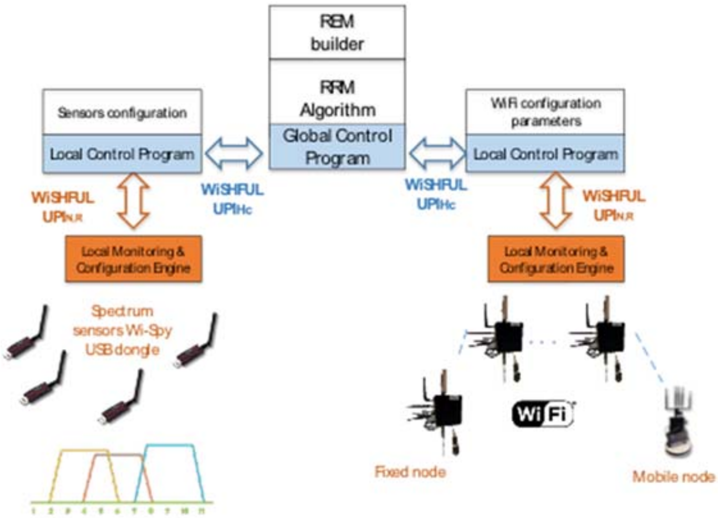
The main objective of this experiment is to assess the benefit of a RRM approach in dense WiFi networks for 2.4 GHz and 5 GHz bands that make use of realistic Radio Environment Maps.

Main challenge(s) of Experiment

The rapidly increasing popularity of WiFi has created unprecedented levels of congestion in the unlicensed frequency bands, especially in densely populated urban areas. The main challenge of this experiment is to assess the benefit of a coordinate management of radio resources in dense WiFi indoor and outdoor scenarios.

Description of setup of Experiment

The generic setup of the experiment is based on the WiSHFUL software architecture (blue and orange blocks) and uses the $UPI_{N,R}$ and UPI_{Hc} interfaces. The Global Control Program is the piece of software that implements the RRM algorithm/strategy that adapts the WiFi devices based on the local observed REM, which is built based on the spectrum sensors.



Main results

- The overall performance of the WiFi network depends on a smart RRM. As an example, for the network under test in the w-iLab.t testbed on the 5 GHz band, we got an aggregated throughput of 28 Mbps in a full co-channel interference scenario and 86.9 Mbps using a configuration of non-overlapping channels.
- It was shown that based on the observation of REMs, it is possible to detect the presence of co-channel interfering links in the network (Figure A);
- It was shown with the portable testbed that a building's concrete floor that separates two WiFi networks using the same channel, act as an effective barrier at 5 GHz, but not on the 2.4 GHz band (Figure B).

- It was shown that REMs are capable of detecting coverage holes on the network, and a suitable RRM strategy can use this information to reconfigure the APs transmit power to reestablish the client connection.
- The technique of AP hand-off was tested to balance the load form one AP to another. Using REMs combined with additional inputs, the RRM strategy was able to reconfigure the network to optimize the client distribution among available APs.

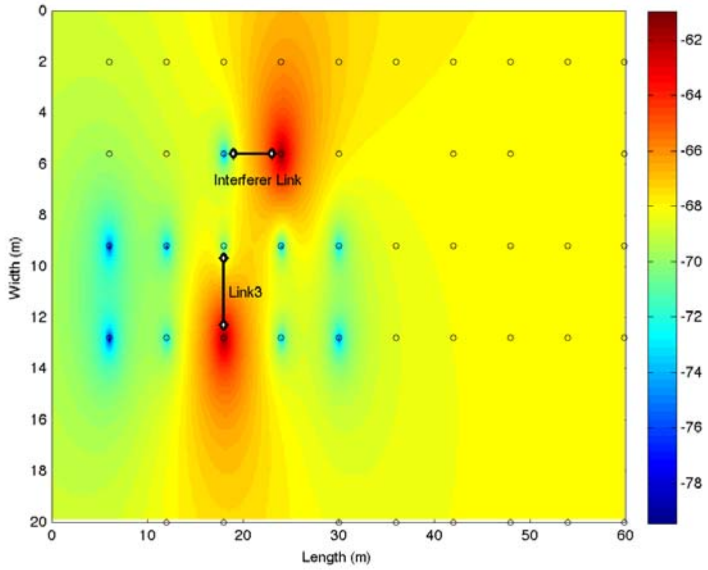


Figure A – Radio Environment Map on the w-iLab.t testbed: Link3 at Channel 48 with 0 dBm transmit power. Interferer Link at Channel 48 with 15 dBm transmitted power.

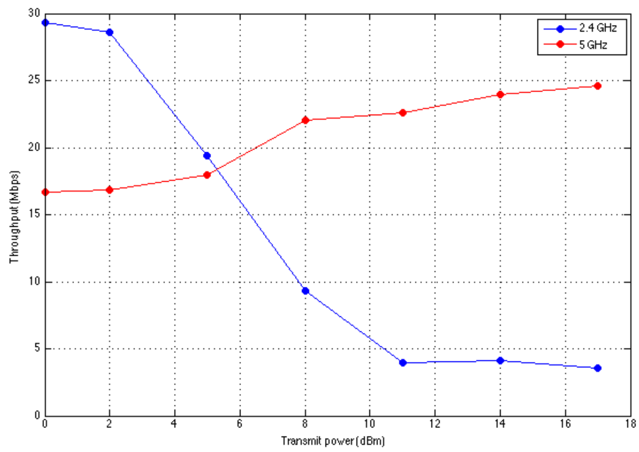


Figure B - Aggregate throughput measurements of two co-channel WiFi cells at 2.4 and 5 GHz band, each on a separate floor.

Conclusions

A WiFi system using RRM and REMs provide enough benefit, compared with a fully uncoordinated WiFi system. The RRM strategy increases the capacity of links under strong interference, and can overcome networks hole coverage or unbalanced cells, however this gain comes with the cost of a relatively high dense network of spectrum sensors (each AP has it own sensor), increasing the cost of deployment.

Feedback

Thanks to the experiment we conducted within WiSHFUL we have tested new strategies to optimize the allocation of WiFi radio channels in order to provide a better WiFi connectivity to ALLBESMART's customers.