Adjacent channel interference in a multi-radio wireless mesh node with 802.11a/g interfaces

Vangelis Angelakis  Apostolos Traganitis  Vasilios Syris

Computer Science Dept.
University of Crete

Institute of Computer Science
FORTH

GOAL: Quantify the Adjacent Channel Interference (ACI) and its impact in wireless mesh nodes with multiple 802.11a/g radio interfaces

Use the partially overlapping channels’ interference quantification proposed in [1] and apply it to 802.11a/g spectral mask & channel spacings.

Our most interesting find is that although adjacent channels in 802.11a are widely considered to be non-overlapping using the model in [1] we calculated and verified through testbed experiments that adjacent 802.11a channels have in fact an overlap that produces significant interference whose impact will be noticeable when the antennas are co-located on a node, even in the case where directional antennas are used.

In [2] authors perform 802.11a testbed experiments to quantify the effect of Adjacent Channel Interference (ACI) on a dual-radio multihop network. In their work they use omnidirectional antennas for their testbed and suggest increasing channel separation and antenna distance as well as using directional antennas in order to mitigate the effects of ACI.

We utilize the SINR criterion for successful reception and produce analytically derived results on up to four 802.11a/g interfaces on a node for:
(i) the cell radius of such a node with respect to the offered data rates for the uplink and the physical spacing of the antennas on the node, and
(ii) the 802.11a/g clear channel assessment (CCA) mechanism.

Such a theoretical analysis is important, since it can be readily extended to newer standards, such as 802.11n, and gives initial insight on the adjacent channel interference effects prior to any delicate, time-consuming testbed experiments.

Simulated Results

CCA ERRORS DUE TO ACI

- 802.11a CCA reports Channel is Clear F - received power is < -92 dBm. Off.
- received power is between -82 dBm and a preamble has not been decoded

Error due to adjacent channel interference

ACI power transmitted from the adjacent-channel 802.11a transmitters on the mesh node. Distance of transmitting interfaces is indicated on the x-axis.

ACI power from a client transmitting to one of the other interfaces of the node tuned to an adjacent channel. The client is assumed to be at the distance indicated on the x-axis and use EIRP of 30dBm.

Testbed Verification

Two laptops with MadWiFi-driven D-link 108AG pci cards send udp traffic for 30 sec to 10m-away 802.11a mini-PCI Atheros based cards on a unix desktop. The laptops were located in our laboratory, with their wireless cards at a distance of 0.5m. Transmission rates were locked at 54Mbps with 150m transmit power and the udp packet size used was 1500 bytes.

FUTURE WORK

Our future work includes uplink and downlink testing through in-lab testbed experimentation with channel emulation over programmable RF attenuators and through experiments on a metropolitan scale mesh network. To a more theoretical twist we intend to revisit the model proposed in [1] and refine it, taking into account the subcarriers of the OFDM scheme used in 802.11a/g. Finally, this enhanced ACI calculation can be utilized in practically any SHM modeling to provide a more accurate estimation of expected results.

REFERENCES


http://www.arc.forth.gr/netlab/

{angelak@ics.forth.gr}  {tragan@ics.forth.gr}  {vsiris@ics.forth.gr}