Fixing 802.11 Access Point Selection*

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As 802.11 deployment and use become ubiquitous, it becomes increasingly important to make efficient use of the bandwidth provided. Unfortunately, 802.11's current access point selection model fails to enable efficient use of access point bandwidth. We discuss why the current 802.11 access point selection model fails, and evaluate alternative models via simulation. Our results indicate that with a small amount of enhanced functionality, 802.11 access point selection can be vastly improved.

As motivation consider the following real-life example: two large lecture halls in Carnegie Mellon University's business school were covered by a single access point that was regularly overloaded. In order to remedy this situation, an additional access point was added, on an available channel, to cover the same area. The result: despite measures to ensure that access point coverage was complete and balanced, the original access point remained overloaded while the new access point picked up a minimal load.

What went wrong? The answer lies in 802.11's minimal support for access point selection. The standard currently merely provides a mechanism for association and disassociation. No information regarding access point load is provided; as a result, the only viable policy for access point selection is to pick the access point with the best signal-noise ratio. An analysis of the signal-noise ratios in the two lecture halls reveals that while the access point coverage is nearly equal, for most locations the original access point has a slightly better signal-noise ratio. The result is that nearly all mobile hosts associate with the original access point leaving it overloaded and the new access point nearly idle.

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While others have publicly proposed solutions to this problem, their solutions have suffered from significant shortcomings such as the need for global load and user information, the failure to consider signal quality, and the need for substantial functionality that is not present in 802.11. We introduce a load sensitive approach to access point selection that is distributed in nature, and amenable to implementation in 802.11 networks with minimal modification to the standard.

Unfortunately, evaluation of this approach is non-trivial. 802.11 access point selection is implemented in firmware which is difficult to modify, and evaluation on a large scale in an operational network is impractical. To overcome these obstacles, we have developed a simulator that utilizes extensive samples of access point signal quality, a model of the physical world, traces of network activity, and traces of user access-point association (used to develop "synthetic models" of user movement through physical space). Using this simulator, we can recreate (in an approximate fashion) the operation of the wireless network during a given period of time. This framework allows us to compare the effectiveness of various access point selection models.

Our preliminary experiments have been aimed at evaluating access point selection mechanisms in the context of the lecture hall scenario described previously. Using network traces from 4pm to 5pm hour on April 30th, 2002 we evaluated the current "SNR Only" access point selection algorithm versus a "Load Sensitive" access point selection algorithm. Under our algorithm, mobile hosts select an access point based on both the current signal-noise ratio as well as the current load at the access point. To avoid oscillation we introduce randomness and hysteresis. Our results show that, as expected, taking load into consideration allows balancing of access point utilization, and provides users with increased network performance.