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Abstract

Cross-layer Design for Interference Mitigation and Mobility Support

in Wireless Access Networks

By

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With the proliferation of WiFi, large-scale deployments of Wireless Access Networks are getting common. While WiFi-based access networks have numerous benefits such as use of inexpensive commodity hardware, operation in unlicensed spectrum and ease of deployment, they fail to provide the level of guarantees and robustness that wired networks or cellular data networks can currently provide. The problem is exacerbated when users have high bandwidth demands. In this regard, we focus on two important issues: mitigating interference and supporting client mobility. Our general goal is to design novel cross layer solutions that utilize the information available in the link-layer layer and the network layers to address these issues. Specifically, we have the following three contributions targeting three specific problem areas related to interference and mobility.

First, the existing routing protocols designed for mesh networks are incapable of reacting quickly to transient degradation of link quality due to fading or interference. We design Deflect, a lightweight and opportunistic mechanism that works underneath the routing layer in a transparent fashion and enables fast local adaptation of end-to-end routes in response to sudden drops in link quality. Second, it is well-known that wireless interference can be mitigated by transmit power control. However, dynamic, uncoordinated transmit power control can also give rise to link asymmetry conditions that affect throughput and fairness. We design Contour, a novel dynamic power management technique that uses slotted symmetric power control, to maximize spatial reuse and avoids link asymmetry. The third key issue we address is supporting seamless client mobility with minimal service disruption. We design iMesh, a mobility management architecture that tracks client movement using MAC layer feedback and updates routes on the backbone network to quickly divert the client traffic to the appropriate access point. We demonstrate the effectiveness of the above three proposed solutions using prototype implementation and extensive experimentation in an indoor wireless testbed.

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