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Abstract

Cross-layer Design for Interference Mitigation and Mobility Support in Wireless Access Networks

By

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Over the past few years, WiFi technology has emerged as the most widely used wireless technology for providing network access to end-users over single hop networks (WLANs) and multiple hop networks (Mesh Networks). Although WiFi-based access networks have numerous benefits such as use of inexpensive commodity hardware, operation in unlicensed spectrum and ease of deployment, they suffers from performance and reliability related problems that arise mainly due to the presence of wireless interference. The problems are exacerbated when there are mobile clients in the network. In this regard, we focus on two important issues: mitigating interference and supporting client mobility. We design novel cross layer solutions that utilizes information available at the link layer and the network layer to effectively address these issues. Specifically, we have the following contributions targeting four specific problem areas related to interference and mobility.

Firstly, existing routing protocols for mesh networks are incapable of reacting quickly to transient link quality fluctuations that are caused by interference. To address this issue, we design a lightweight opportunistic protocol called ***Deflect*** that operates transparently underneath the routing layer and achieves fast local adaptation of end-to-end routes. Secondly, in dense WLAN deployments, co-channel interference can significantly degrade the achievable network throughput. We design a novel dynamic transmit power control technique called ***Contour*** that maximizes spatial reuse while avoiding link asymmetry problem. Thirdly, a malicious user can create interference and jam all communications on a channel. To address such jamming attacks, we design a ***Channel Hopping*** protocol that improves the security and resilience of WiFi networks. Finally, we address the issue of supporting seamless client mobility with minimal service disruption for a mesh network. We design a mobility management architecture called ***iMesh*** that tracks the client's location using link layer feedback information and quickly updates the routes on the mesh network for mobile clients. We design and implement system prototypes of our proposed solutions on commodity hardware and perform extensive experimentation to demonstrate their effectiveness on realistic wireless testbed deployments.

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