Secure and Equitable Access Point Placement Under Node Compromise

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Abstract:

We study attack-resilient access point (AP) placement for public Wi-Fi in high-density areas such as airports, stadiums, and urban centers where targeted node may compromise and AP failures can degrade service quality. We discuss an optimization framework combining proportional-fairness objectives that minimize log-uncoverage probabilities to ensure equitable coverage across zones with Bertsimas-Sim robustness and data-driven connectivity probabilities. Connectivity between candidate AP locations and zones is modeled via a probability p(a,z) estimated using (i) an analytical frequency baseline, (ii) logistic regression, and (iii) Random Forest; spatial diversity is enforced through clustering constraints (K-means, distance-based, or similarity-based). In a foundational large-scale deployment, robust designs improve worst-case served population by 64.5% under five simultaneous AP failures without increasing the deployed AP count. Under targeted attacks (10-20 compromised nodes) and fixed AP budget, Random Forest with K-means achieves 91.3% average coverage for 10-node attacks and maintains the best worst-case coverage as attacks intensify. The results indicate that combining learned probabilities with robust, fairness-aware optimization yields resilient Wi-Fi layouts suitable for adversarial environments.

Keywords:

Access Point Placement, Robust Optimization, Proportional Fairness, Wireless Security, Targeted Attacks, Random Forest, K-means Clustering, Resilient Wi-Fi Planning.