Bibliographic work*

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1 Results analysis

Five prespecified access point topologies have been considered to compare how do they affect the placement and movement trends of the jammers. To achieve this the simplified bilevel mixed- integer program [BLMIP] has been used.

The Partite topology had three clusters with demand points clustering around them. The Perimeter topology distributed access points along the region's perimeter, allowing free movement of demand points. The Dense topology featured a central hub with clustered access points, catering to high demand independently. The Spacious topology randomly distributed access points to avoid proximity, resulting in demand points within range of one or two access points. The Median topology had uniformly distributed access points along diagonals and central lines, with clustering in the center, resembling a campus with a central area of high connectivity demand.

For all five topologies, three experiments with 10, 25 and 50 AP, each with a capacity of 15, 5 jammers with jamming radius of 150 feet, and 5 time periods. Each region was 1 square mile. The demand was realized ten times, with 100 demand points, and the results were averaged.

It was found that access point placement near concentrations of demand points was crucial for ensuring robust network connectivity. However, access points too clustered together give jammers an easier time on severing connections. Therefore, the optimal solution should find a balance between these two factors.

Sensitivity has also been proved, concluding that adding a set of new access points did not improve overall connectivity. Meanwhile, were more jammers to be added to the original problem, the set of new APs would become significantly important. **??** is a generalized utility function considering three aspects: range, unity and tolerance. The range describes signal strength for access-demand point connections, unity represents uniform signal strength with either connected or unconnected links and tolerance introduces a threshold below which connections are considered too weak to be useful and are treated as unconnected.

2 Conclusions

The optimal placement of access points is crucial to ensure maximum connectivity for demand points in various environments, including university campuses. This optimal topology will also maximize connectivity in the presence of jammers, considering both non-additive and additive models. Achieving a proper placement requires striking a balance between placing access points near concentrations of demand points and avoiding the formation of clusters. In this regard, the Partite and Median topologies demonstrated greater robustness against jamming attacks when considering utility as total signal strength, number of connections, or tolerance allowance.

While this research considers the placement of both access points and jammers, the placement of demand points has not been taken into account. Considering this would lead to a stochastic problem rather than a deterministic one.

References

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