Topology Control in Heterogeneous Wireless Ad-hoc Networks

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1. Summary

Both papers [1] & [2] deal with localized topology control in heterogeneous wireless ad-hoc networks and prove some properties such as connectivity or bounded out-degree of the presented structures.
The first paper [1] is based on general graphs. It proposes two structures; the Directed Relative Neighbourhood Graph (DRNG) and the Directed Local Minimum Spanning Tree (DLMST).
The second paper [2] is based on mutual inclusion graphs. It presents three structures a sparse structure based on the Relative Neighbourhood Graph (RNG), a power spanner structure based on Gabriel graphs and a degree-bounded spanner structure based on Yao graphs.

2. Paper [1]

Both of the two presented structures can be built in three phases, namely the information collection phase, the topology construction phase and the optional phase in which they transform the structure to a new one with only bi-directional links.
All three phases are not well described in this paper since the authors leave out important information such as what kind of information a message should contain, how a node can detect the reachable neighbourhood or the construction of a local minimum spanning tree. For some of these problems there are references but in a paper presenting algorithms for building new structures I would expect more details.
It would be nice to know how they will find the reachable neighbourhood of a node and how long this can take since this information has to be propagated along a path from each receiving neighbour node to the specific sending node.
This paper shows in a theoretical manner that it is possible to create strongly connected structures based on general graphs. If we want bi-directionality we also need a mutual inclusion graph as underlying structure.

3. Paper [2]

In this paper the algorithms and the results are described in more detail than in the first paper.
The sparse structure based on RNGs and the power spanner structure based on Gabriel graphs are both not as good as the degree-bounded spanner structure regarding the power consumption at runtime and the out-degree of a node. I think that the first two structures where mentioned to show the well-defined characteristics of the third one even though the first two structures also have there own well-defined characteristics. For example the sparse structure based on RNG consumes much less energy for building up the whole structure then the other two structures.

4. Conclusion

Both papers are very interesting and give a good overview about the occurring problems in topology control algorithms especially in the case of heterogeneous networks.
The structures presented in the second paper have stricter characteristics, such as the power and length spanner, than those presented in the first paper. This is a consequence of the fact that the structures of the first paper are based on general graphs while the structures of the second paper are based on mutual inclusion graphs.
Unfortunately none of the two papers tells where exactly there solutions can be applied in practice. This would be an open question and an interesting future research topic.
I suppose that in the future such topology controlling algorithms will become more important since the number of mobile devices is continuously growing.

5. References

[1] Ning Li and Jennifer C. Hou, Topology Control in Heterogeneous Wireless Networks: Problems and Solutions, Department of Computer Science, University of Illinois at Urbana-Champaign, Urbana, IL 61801, {nli,jhou} @cs.uiuc.edu, INFOCOM 2004
[2] Xiang-Yang Li, Wen-Zhan Song, Yu Wang, Localized Topology Control for Heterogeneous Wireless Ad-hoc Networks, MASS 2004