Location Services

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1. Overview

In most geographic routing algorithms, the position of the destination of a message has to be known by the sender. This is what location services are for: they provide lookup and publish algorithms to exchange information about geographic positions of nodes in a network. The papers [1] and [2] present possible solutions. The main idea of both papers is to distribute location information of a given node over the whole network, denser in the nearby neighbourhood, sparser with growing distances.

2. Evaluation: GLS

The work by Li et al. [1] is oriented rather practically. To me, this pioneering work was quite inspiring to read. The proposed solution is promising, which is also shown by the simulation. On the other side, I missed some points: the authors don't give upper bounds for the speeds the nodes can move in order to still have a reasonable service; nodes in the simulation move at speeds of at most 10 m/s. Also, the nodes in the simulation are distributed evenly over the whole network, which might be unlikely in reality. Simulations with a focus on such restrictions have been made; [3] for example shows that queries are much more likely to fail if the maximal speed of the nodes is increased to 50 m/s.

Further on, there are only little or no indications at all on the following questions: What happens if new nodes join an existing network and how long does it take until the service is again in a more or less consistent state? How is location information stored by nodes that intend to shut down redistributed?

A search in the internet referring to this work shows that GLS (Grid location service) is still examined.

A little detail: figure 4 in paper [1] is erroneous. Several location information entries are missing or in the wrong place. This might be misleading for the reader wanting to understand how a lookup is done.

3. Evaluation: LLS

The paper by Abraham et al. [2] is more theoretical. Worst case and average case analysis are provided for the proposed solution. This approach comes closer to the ultimate goal of location services: making the service asymptotically as efficient as its underlying geographic routing algorithm.

At first sight, LLS (Locality aware location service) seems to be more resilient against node failures. But in the final LLS-algorithm shown in the paper, node failures can also lead to query failures: When a location lookup has to follow the location pointers, a pointed to node may be down. A solution to this issue might be backtracking to another corner of the square where location pointer dereferencing began, but this would be expensive.

LLS is more failure resilient than GLS. While crossing grid boundary lines in GLS is a problem, the cost of updating location information in LLS remains proportional to the distance of the move.

4. Conclusion

The two papers were very interesting to read. However, privacy is mentioned in neither of them. The nodes have no control on where their location information is stored. On the other hand, if this is not a problem, a node can not only publish its location, but also the path it intends to take in the next time if this is known. This could be an improvement in order to make updates necessary less frequently.

A point the two papers base on is that each node always knows its own position. That is, each node has to be aware of its location, for example by having a GPS module. This is quite a high demand, since this could make a node more expensive, bigger and more power-consuming. For this, approximations to the real position could be appropriate.

I ask myself, if other models not based on static geographic coordinates could be helpful. For example on the freeway, cars normally cruise at high speeds. Thus, they would have to update their location information more often, stressing the network. But in fact, the relative distances of the cars are often more stable than their absolute positions.

5. References

[1] J. Li, J. Jannotti, D.S.J. De Couto, D.R. Karger and R. Morris. A Scalable Location Service for Geographic Ad Hoc Routing. MobiCom 2000

[2] I. Abraham, D. Dolev and D. Malkhi . LLS: a Locality Aware Location Service for Mobile Ad Hoc Networks. DIALM-POMC 2004

[3] S. Sharma, V. Alatzeth, G. Grewal, S. Pradhan and A. Helmy, A Comparative Study of Mobility Prediction Schemes for GLS Location Service. IEEE VTC Conference, Los Angeles, Sept 2004