LOCALIZED ANALYSIS OF AN AD HOC MOBILE NETWORK

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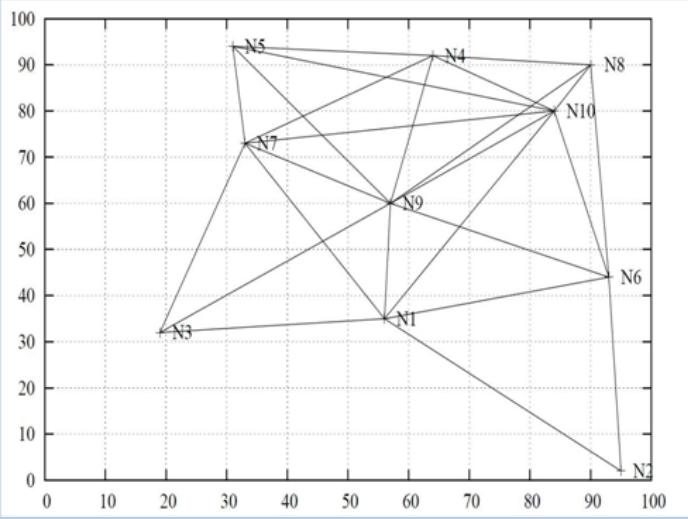
In a paper previously published by Professor Peter Taylor, he utilised static optimisation methods (which require global network information) to derive optimal flows within an ad hoc mobile network. Using this research as a framework we were able to find a dynamic way of optimising an ad hoc mobile network using information locally available to each node.

WHAT IS AN AD HOC MOBILE NETWORK?

An ad hoc mobile network is a self configuring network that requires no infrastructure. Each handset may act as a source, transit or destination node for a given flow of data. If a source node wishes to communicate with a destination node which is out of range, then other nodes must co-operate to provide a multi-hop route to the destination node. Each flow in the network consumes some of the total power capacity at each participating node.



As was done in the 2011 paper by Krzesinski, Latouche and Taylor, our model is such that the source node derives utility from any particular flow. The optimal solution is taken to be the set of flows which maximises total utility of all nodes within the network,

$$max_{y_r} \sum_{r \in R} U(y_r)$$

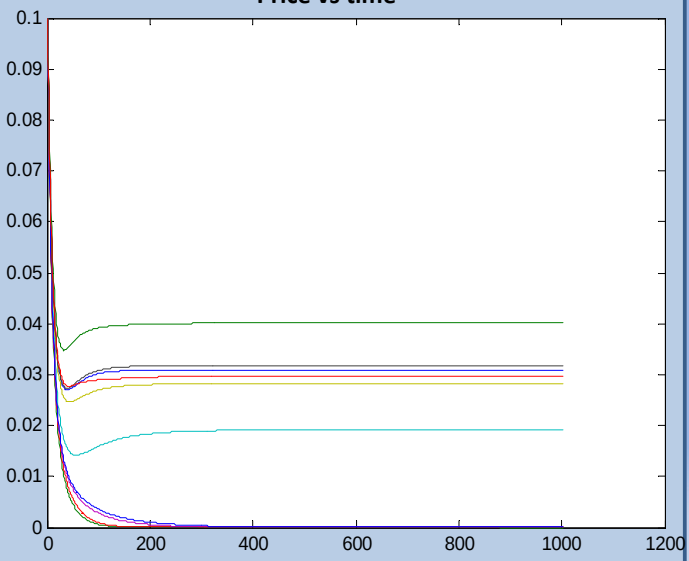
subject to the constraint that all nodes operate at or below maximum operating capacity.

A LOCALIZED APPROACH

In our research we proposed a regime in which each node transmits their individual price signal to all other nodes. On the basis of this information and the routes available in the network, each node computes the optimal flows for which they are the source. Price signals are updated using the differential equation:

$$\frac{d\varepsilon}{dt} = \frac{k\varepsilon(\rho(t) - P)}{P}$$

Price vs time



Intuitively, if a node is operating below maximum capacity its price will decrease and hence it will attract an increased volume of traffic. When a node is operating above its maximum capacity, then that nodes price increases and this will cause less flow to be directed toward this node. Using Matlab we showed that the network converged to the same flows that were derived using static optimisation methods.

THE VACATION SCHOLARSHIP EXPERIENCE

During our vacation scholarship we were introduced to the research side of mathematics. We learnt some techniques for approaching difficult problems that may arise in industry or in further research. As a group we also attended the ANZIAM conference and presented our research findings. ANZIAM exposed us to the cutting edge of applied mathematics and gave an insight into the higher mathematics community. The Vacation Scholarship was an invaluable experience and we'd advise anyone considering further study in mathematics to apply.