Data Collection in Delay Tolerant Mobile Sensor Networks using SCAR

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Overview

Sensor devices are now present in virtually all sorts of items, from vehicles and furniture to humans and animals. This generates networks of wirelessly connected devices with topologies which could be very dynamic. The amounts of data generated by these applications are usually quite large, however, fortunately, the data is, in most cases, also *delay tolerant*, in the sense that it can wait in the network for quite a while before being collected.

The scenario we envisage in this demonstration is one where the mobile sensor nodes (e.g., animals, vehicles or humans) route data through each other in order to reach sink nodes. The nodes could be either fixed, or mobile.

SCAR

Our protocol, SCAR is a routing approach which uses prediction techniques over context of the sensor nodes (such as previously encountered neighbours, battery level, etc.) to foresee which of the sensor neighbours are the best carriers for the data messages.

The decision process by which nodes select the best carriers is based on **prediction of the future evolution of the system**. Our solution relies on the **analysis of the history of the movement patterns** of the nodes and their **collocation with the sinks** and on the evaluation of the **current available resources of the sensors**.

In particular, each node evaluates its change rate of connectivity, collocation with sinks, and battery level. The analysis is based on **Kalman filter-based prediction techniques**, and **utility theory**. The following utility function is used to find out the delivery probability for each node:

$$U(s_i) = w_{cdc}\,\hat{U}_{cdc}(s_i) + w_{coloc}\,\hat{U}_{coloc}(s_i) + w_{bat}\,\hat{U}_{bat}(s_i)$$

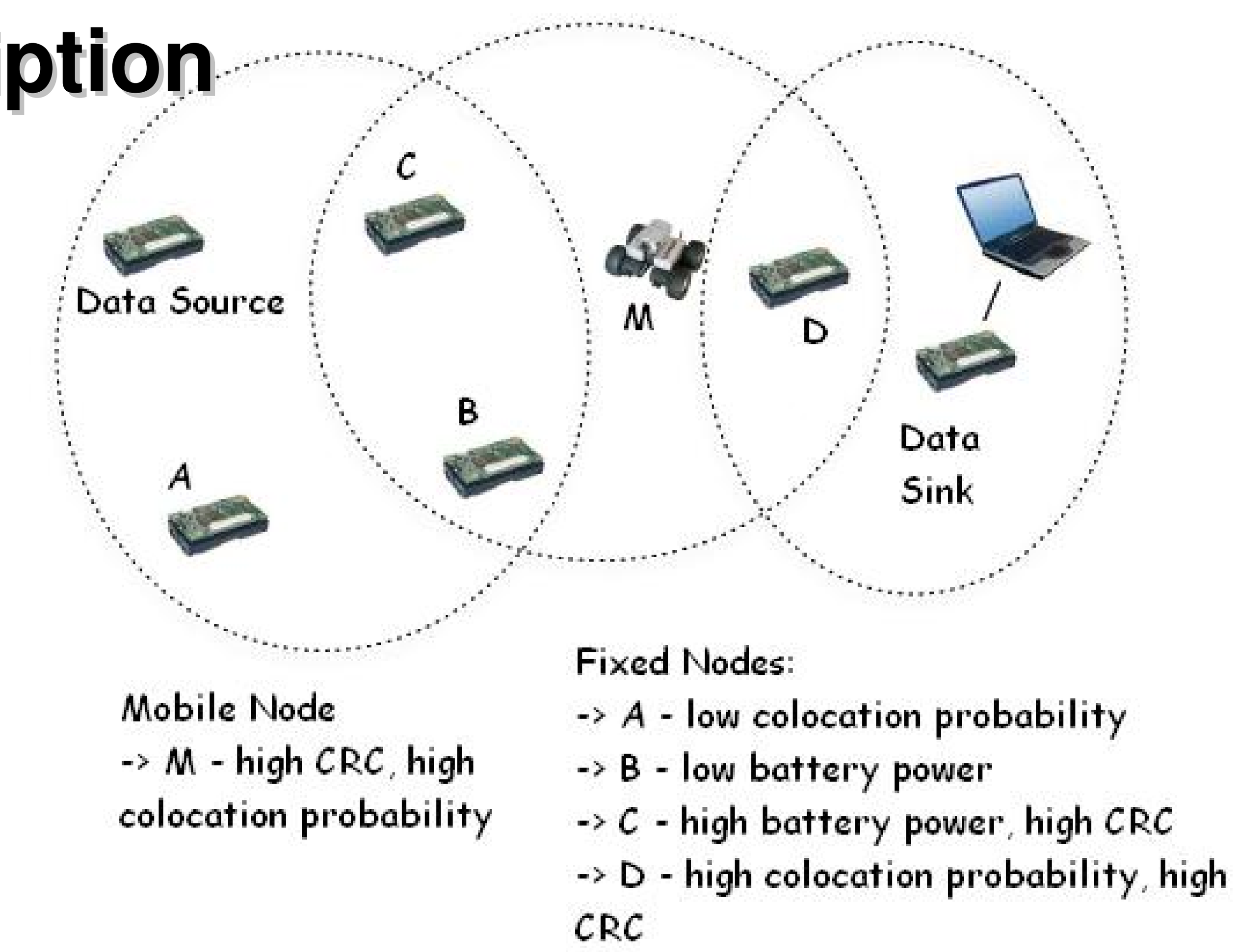
where:

- $\hat{U}_{cdc}(s_i)$ measures the change degree of connectivity of node s_i, which is defined to be the number of connections and disconnections that a node experienced in a set period of time
- $\hat{U}_{coloc}(s_i)$ measures the collocation with the sinks
- $\hat{U}_{bat}(s_i)$ gives an estimation of future battery level.

Demo Description

Demo setup:

- source is a mote (Tmote Sky) sitting on a desk, sending readings from its light sensor regularly
- sink is another mote attached to a laptop, which displays the messages received
- there are a couple of intermediate nodes between the source and the sink – some of them are stationary, while others move on a predefined route



- All sensors have the Contiki kernel running on them. SCAR is implemented using protothreads, which deal with the sending and receiving of messages. All motes send routing messages regularly to other motes nearby. The source sends its sensor reading to the appropriate mote (the one with the best delivery probability), which then transmits it to the sink, or, in case it meets another mote, to that mote – given that it has a better delivery probability.

Reference:

C. Mascolo and M. Musolesi (2006). SCAR: Context-aware Adaptive Routing in Delay Tolerant Mobile Sensor Networks. In Proceedings of the Delay Tolerant Networks Symposium. ACM International Wireless Communications and Mobile Computing Conference (IWCMC) 2006. pp. 533-538. ACM Press.