GeoKad - P2P Localization System

Marco Picone, Michele Amoretti, Francesco Zanichelli
Department of Information Engineering - University of Parma - http://dsg.ce.unipr.it

Architecture

Project GeoKad defines and implements a P2P overlay network where each node (software programs running on a mobile device) to be aware of nodes that are "geographically" (rather than "virtually" on the network) close to them. The requests related to the position of a specific peer are not obtained by querying a central node, but routing them through the P2P overlay network possibly scaling up to millions of nodes, way beyond what can be achieved with a central server.

This approach also increases the availability of updated information across the network itself.

Each peer stores a set of lists (called GeoBuckets) of neighbors, each list being sorted according to distance. These lists are regularly updated in order to have the latest information on the position of nodes.

GeoKad introduces the concept of Distributed Geographic Table (DGT), that refers to a distributed system where a participating node can efficiently retrieve nodes or resources (data or services) placed near any global position. Responsibility for maintaining information about the position of active peers is distributed among nodes, in such a way that a change in the set of participants causes a minimal amount of disruption.

Preliminary Evaluation

GeoKad has been implemented and preliminary evaluated using the discrete event simulation tool called DEUS with generated a list of 1000 random GPS coordinates centered in Frankfurt. Starting from this list we have created (offline) 3000 real paths between different available points, according to Google Maps API. Peers gradually join the network with different random times generating a really dynamic situation.

In the analyzed scenarios each node has 10 GeoBuckets (9 + 1 because the last one is for nodes outside the zone of interest) spaced by 1.5km, and receives from the bootstrap node a small list of 20 nodes.

- The percentage of misses is globally very low and in particular for lower GeoBuckets is around 10% which means in the first four list (radius of 6 Km) we obtain a high knowledge about neighbors.

- Message rate gradually decreases during the simulation because nodes have more contacts in their GeoBuckets and it is easier to send new information to other peers. Results show that with a high number of nodes a reduced number of messages is needed. In fact, a high number of peers routes new discovery messages that allow single nodes to keep in touch with new neighbors during different iterative steps of the lookup procedure.

Applications

- Inter-Vehicular Networks
- Geo Social Applications
- Road/Highway Monitoring
- Emergency Management
- Geo Advertisement

Demo Video & Information: http://dsg.ce.unipr.it/geokad