# RoadAlarm

## A Spatial Alarm System on Road Networks

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www.cc.gatech.edu/projects/disl/RoadAlarm

## Introduction

**Spatial Alarms**

- Extend the concept of time-based alarms to **spatial** dimension
- Remind us when we **enter** some predefined location of interest in the future

**Target Applications** of Spatial Alarms

- location-based advertisement system, factory danger zone alert system, sex offender monitoring system, etc.

**Categorization** of Spatial Alarms

- ***Private*** : one subscriber who is also the publisher
- ***Shared*** : one publisher and several subscribers approved by the publisher
- ***Public*** : one publisher and no restriction on subscribers

**Challenges** of spatial alarm processing

- Energy consumption of mobile devices
  - Negligent management of spatial alarms can lead to excessive energy consumption of mobile devices, especially those with limited battery power
- Scalability
  - It should scale to large number of spatial alarms and growing base of mobile users
- Accuracy
  - It should ensure zero or very low alarm miss rate

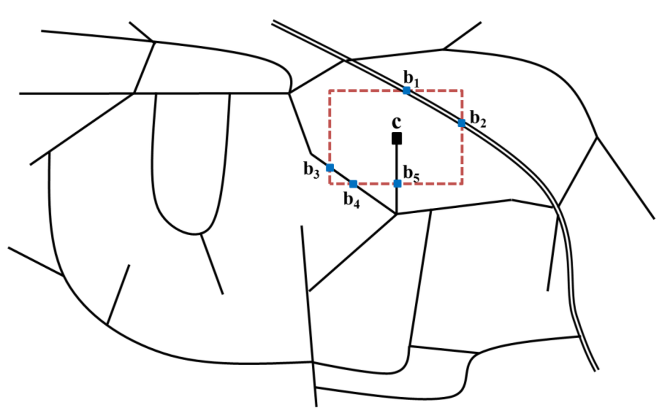
## Approach

**Design principle**

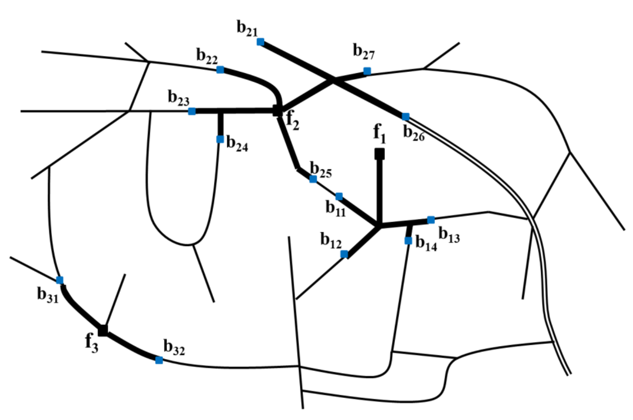
- Utilizes spatial constraints on **road networks** and **mobility patterns** of mobile users to
  - **increase the sleep time of mobile users** (i.e. energy saving)
  - **reduce computation cost of alarm checks**

**Baseline approach**

- **Define road network-based spatial alarms**
  - Use road network-based spatial alarms to replace rectangular alarms
  - Use road network distance to replace Euclidean distance
- **Calculate the sleep time of each moving object**
  - When a moving object wakes up, find the nearest spatial alarm based on the road network distance
  - Use the travel time to the nearest alarm as the sleep time of the object
- **Reduce the number of spatial alarms to be evaluated**
  - Subscriber-based filter: consider only spatial alarms subscribed by the object
  - Euclidean lower bound filter: utilize the fact that the road network distance between two locations is at least equal to or longer than the Euclidean distance between them



Rectangular alarms



Road network-based alarms

## Optimization

**Goal**

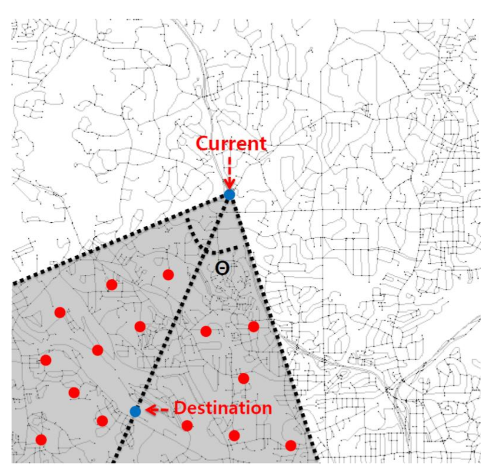
- To reduce the number of *expensive* shortest path computations by restricting the search space, when we find the nearest spatial alarm

**Steady Motion Assumption**

- Mobile objects on the road network usually move along its current direction for a certain period of time.

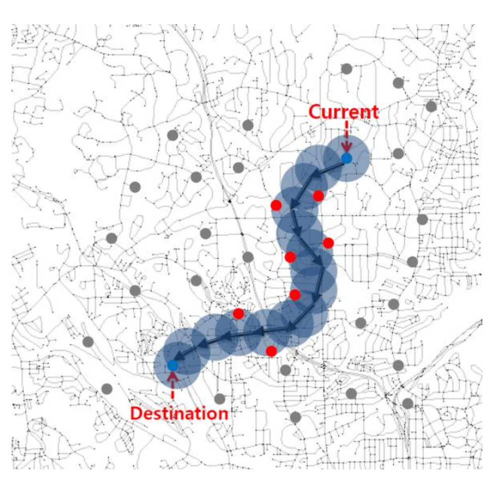
**Destination-based motion-aware filter**

- Moving objects will move toward their destination within the confidence degree θ, thus only those spatial alarms which reside in the area defined by the destination vector and θ will be examined
- Find the nearest spatial alarm in the limited search space using the baseline approach




**Shortest path-based motion-ware filter**

- Calculate the shortest path from the current location to the destination for each moving object
- Select some spatial alarms within a boundary distance *d* from the shortest path
- When a moving object *m* wakes up, this filter retrieves the stored spatial alarms of *m* and then finds the nearest spatial alarm among them




## Demonstration