

# TinyCasper: A Privacy-Preserving Aggregate Location Monitoring System in Wireless Sensor Networks

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## Location Systems

**Centralized Approach**  
 E.g., BAT [WINET01] and Active Badge [TOIS92]

**BAT – Ultrasonic Transmitter**



**BAT - Deployment**



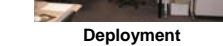
<http://www.cl.cam.ac.uk/research/dtg/attarchive/bat/>

**Distributed Approach**  
 E.g., Cricket [MOBICOM00]

**MICA2 Cricket Mote**



**Deployment**



<http://cricket.csail.mit.edu/>

**Accuracy is within a few centimeters!!!**

## Privacy Threats in Location Systems



In fact, with a few exceptions, such as video surveillance of restroom stalls, employers can gather any and all information about their employees.

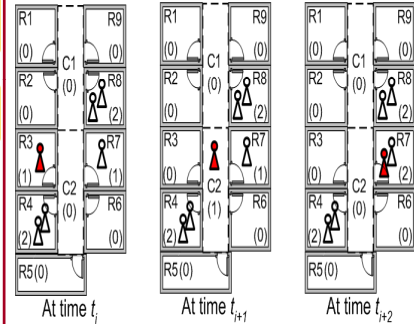
Limit employees to 15 minutes of restroom time during an eight-hour shift

The nurses complained that they felt like prisoners ordered to wear tracking bracelets.

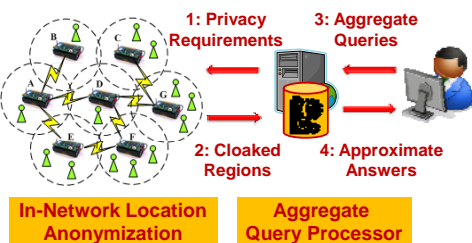
Despite employee complaints and the potential for abuse, location tracking by private employers is almost completely unregulated.

**IT'S 11 AM. Do You Know Where Your Employees Are? Ineffective Use of Location-Based Technologies in the Workplace**

<http://library.findlaw.com/2005/Mar/10/163970.html>

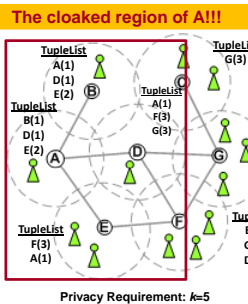


## Architecture

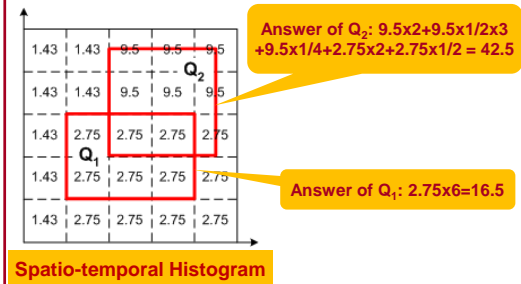


## Location Anonymization

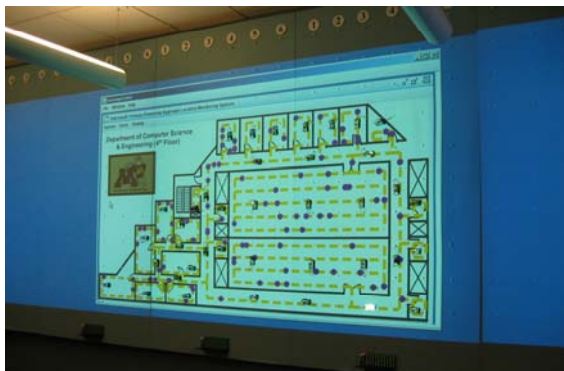
- Broadcasting Step**  
Store and forward the received information until all its neighbors have found at least  $k$  objects
- Spatial Cloaking Step**  
Select the peers in the tuple list with the highest score, i.e., no. of users/distance to the peer, until at least  $k$  objects are found
- Maintenance Step**



## Query Processing



## TinyCasper Running on a Test-Bed



- On the TinyOS/Mote platform in nesC with 39 MICAz nodes
- MIB510 serial gateway connected to a PC as a base station
- Floor plan (the 4th floor of the Computer Science & Engineering Building at the UMN) projected on three 4-foot by 8-foot boards using 2 projectors

## Server-Side User Interface

**Cloaked Regions from Sensor Nodes**

**Spatio-temporal Histogram and Aggregate Queries**