

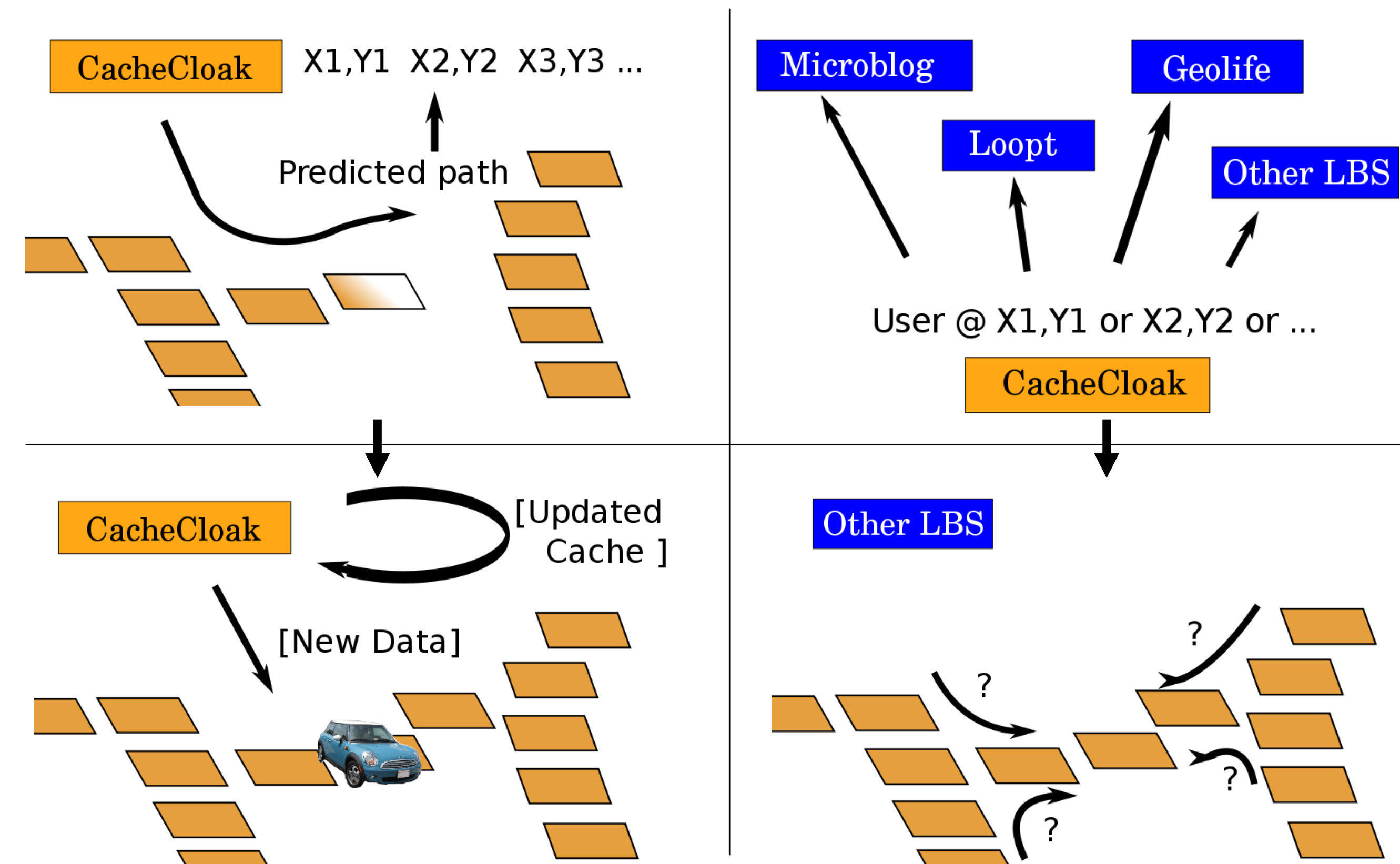
Problem Statement

- ❖ **GPS is becoming ubiquitous**
Many new cell phones have GPS
Localization accuracy increasing
- ❖ **Location Based Services (LBSs)**
Location queries, data, directions
Examples; Microblog, GeoLife, Loopt
- ❖ **Privacy concerns exist**
Constant high accuracy location streams
Tracking from home to sensitive location possible



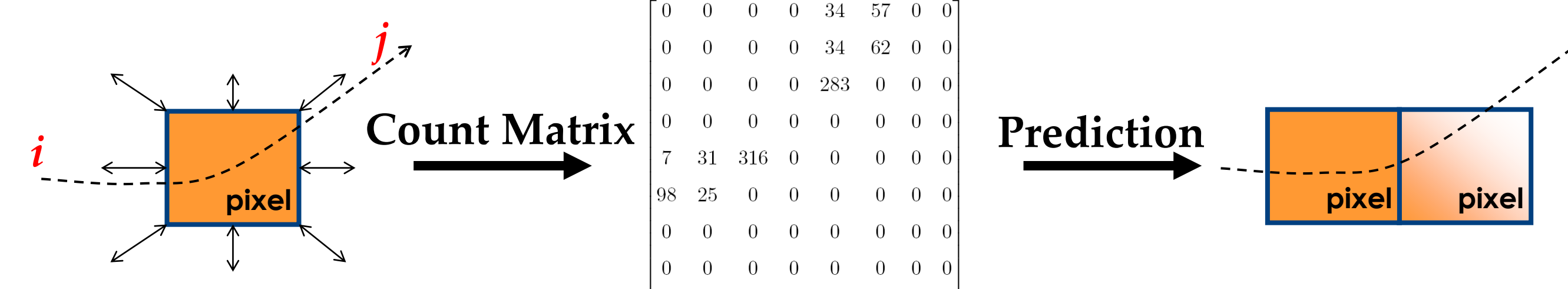
Figure (1): Micro-Blog. Sourced from: Romit Choudhury, Micro-Blog, Mobisys '08.

Privacy Through Prediction



Implementation

- ❖ **Historical data used to predict motion**
Map split into 10 m pixels, each with 8x8 matrix
Calculate Prob(Leave from j | Entered from i)



Limitations of existing work

k -anonymity

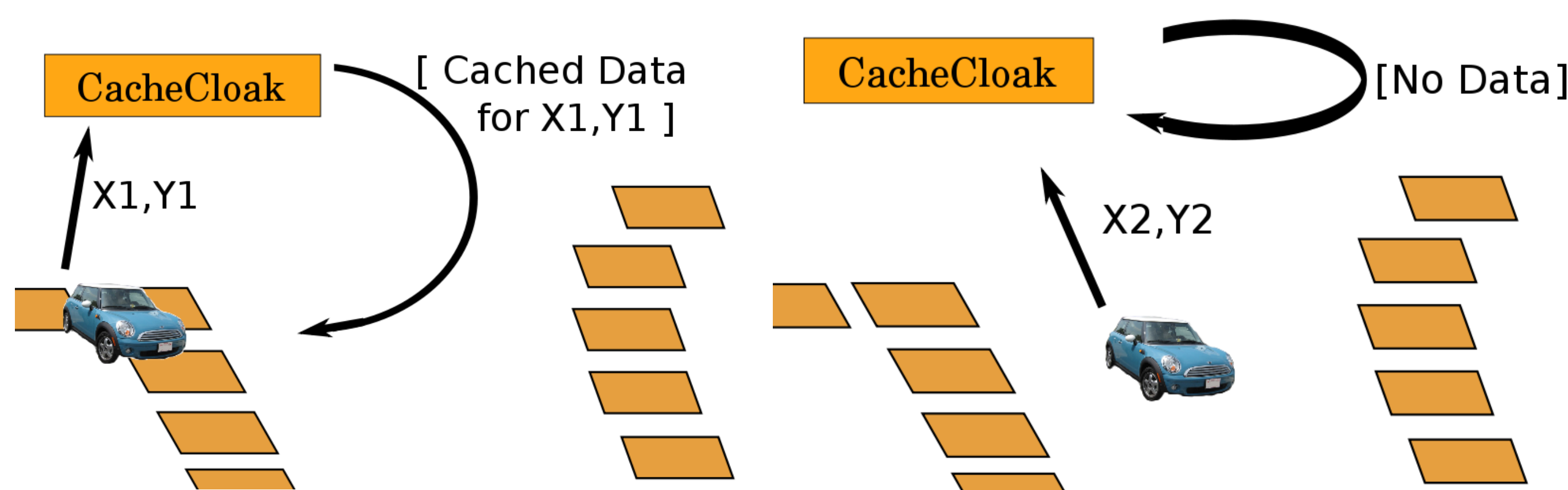
- Return region with k users

Path Confusion

- *A posteriori* suppression

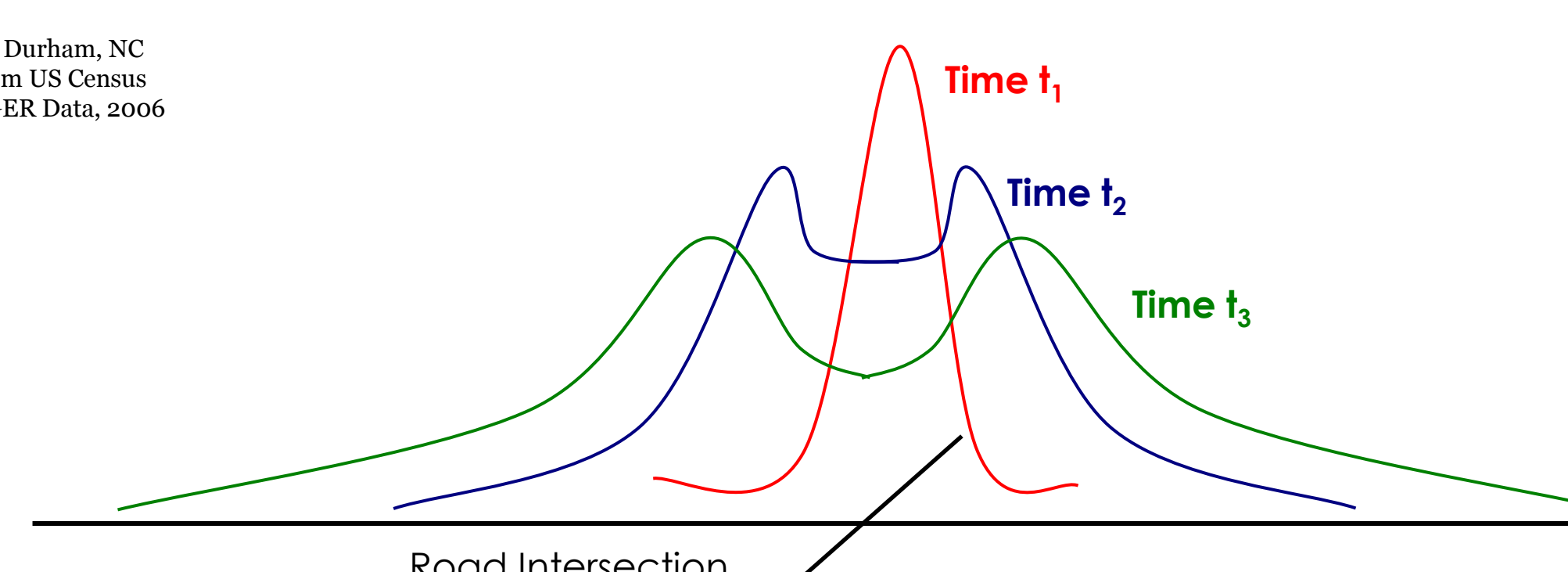
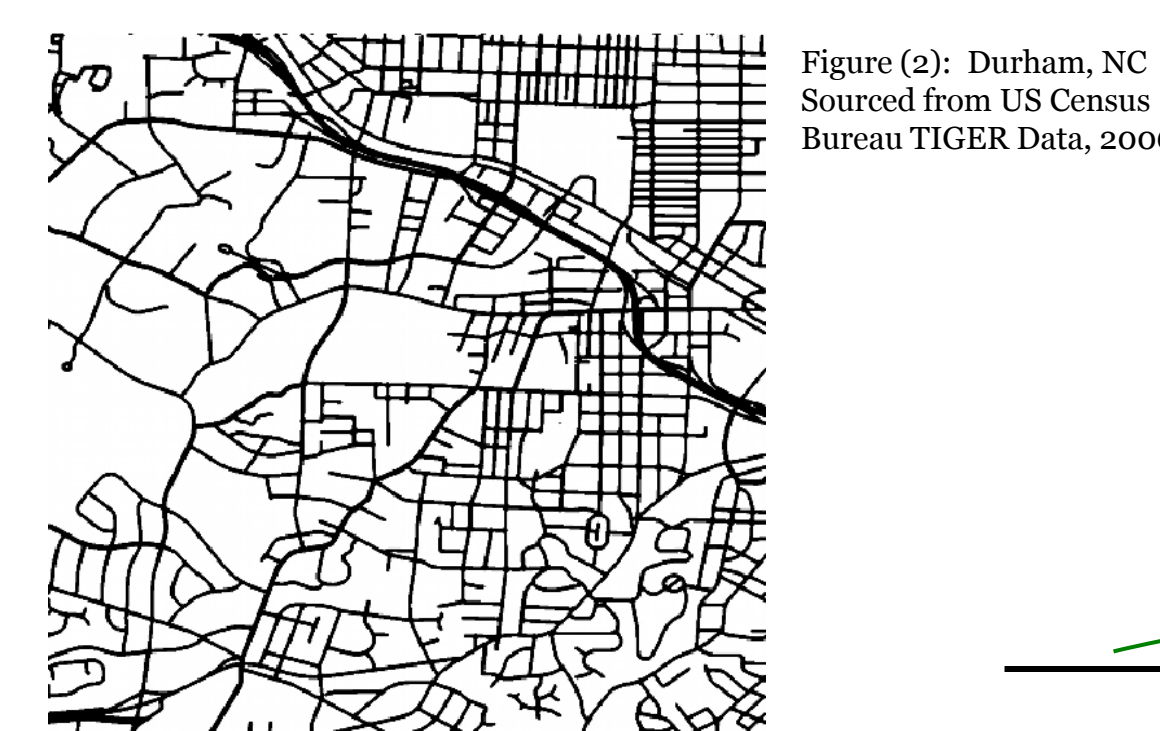
- ❖ **Existing techniques have QoS problems**
 k -anonymity reduces spatial accuracy
Path confusion creates delays, reduces availability

Spatial Caching



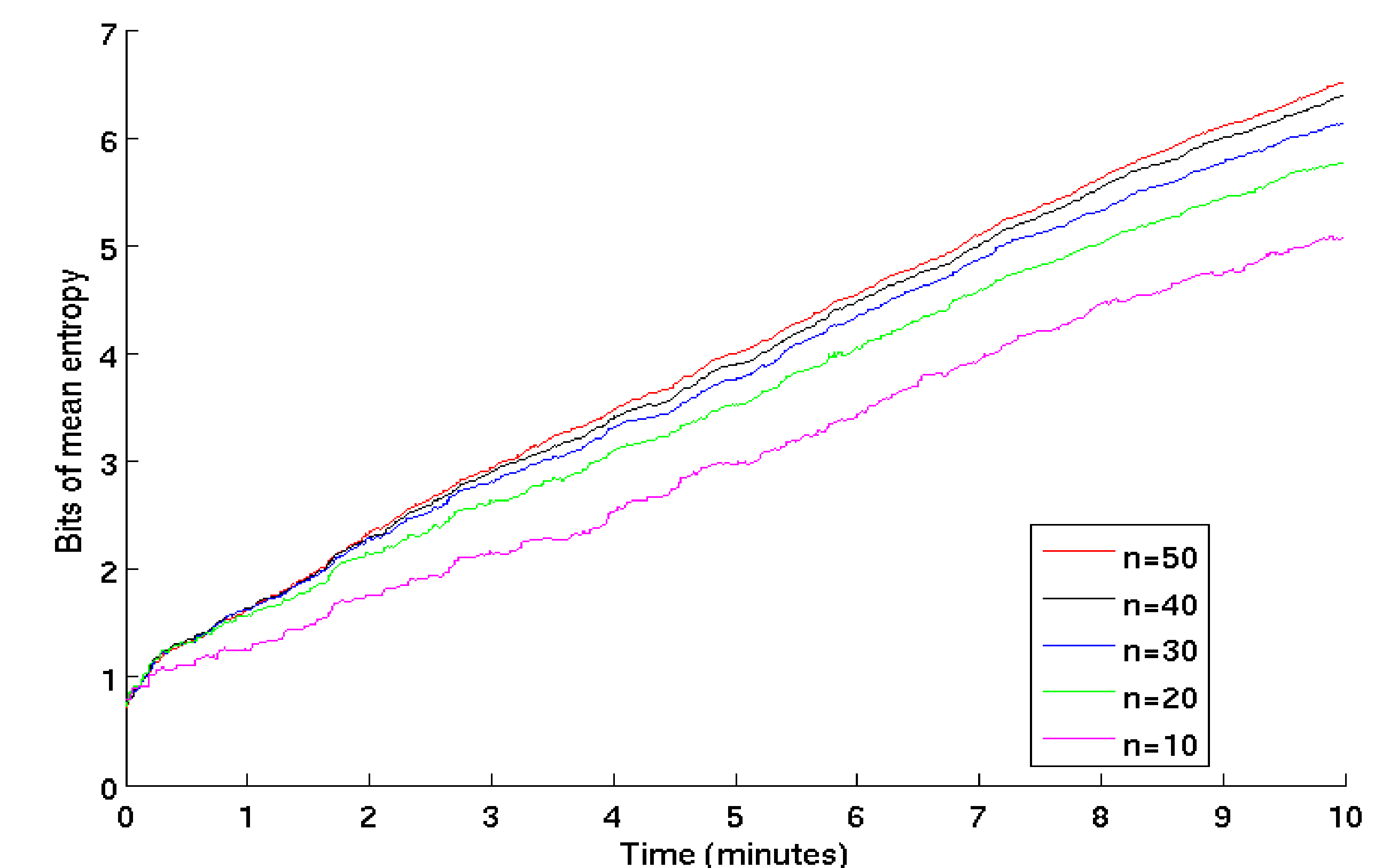
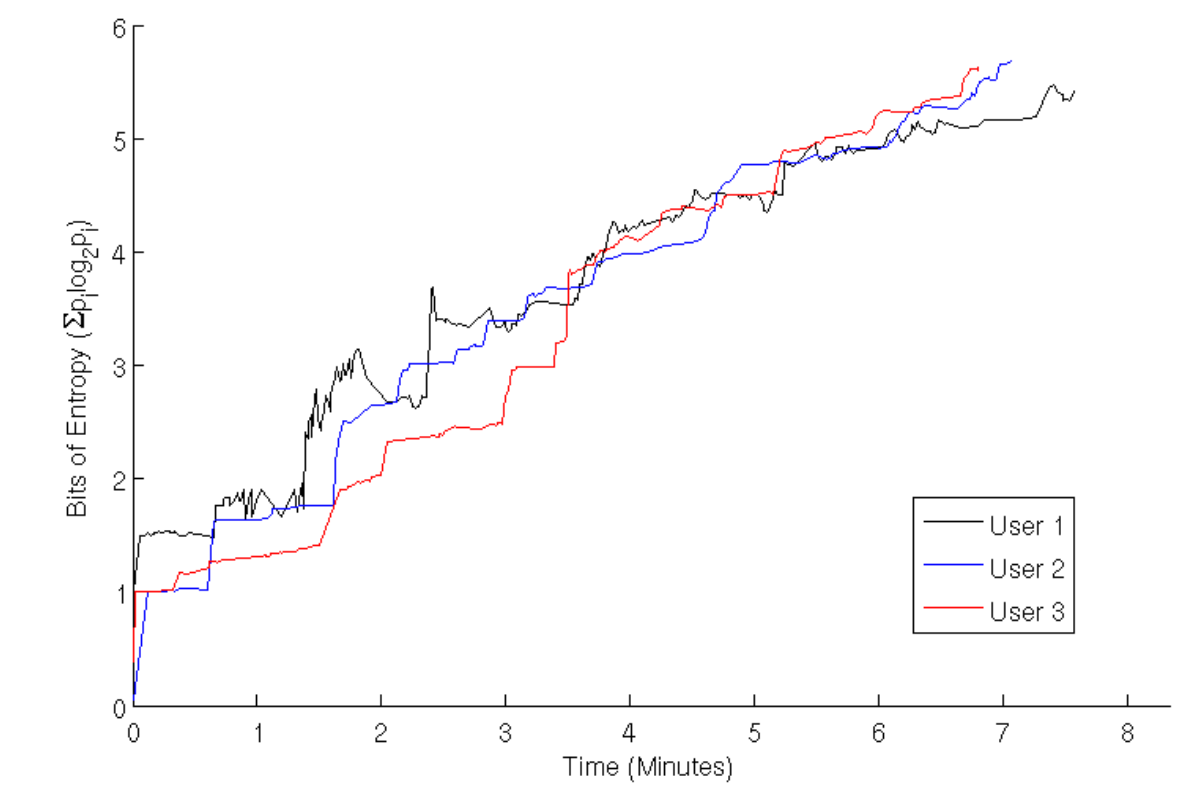
Modeling & Simulation

- ❖ **Traffic simulated in Durham, NC**
USCB GIS data with VANETMobiSim on 36 km²
- ❖ **Diffusion-tracking attacker model**
Probability of user's presence diffuses per $P(j|i)$



Results

- ❖ **Users quickly & effectively anonymized**
Less than 5 minutes to multiple bits of entropy
Works in densities as low as 1 user/ 3.6 km²



Conclusions

- ❖ **Predictive cloaking provides privacy**
No degradation of accuracy or availability
Incurs only a computational cost for LBS/server

Future Work

- ❖ **Adaptive entropy with prediction branching**
- ❖ **Investigate distributed version**
- ❖ **Use personalized mobility modeling**
- ❖ **Make context-sensitive**