



Thrifty Tracking: Online GPS Tracking with Low Data Uplink Usage

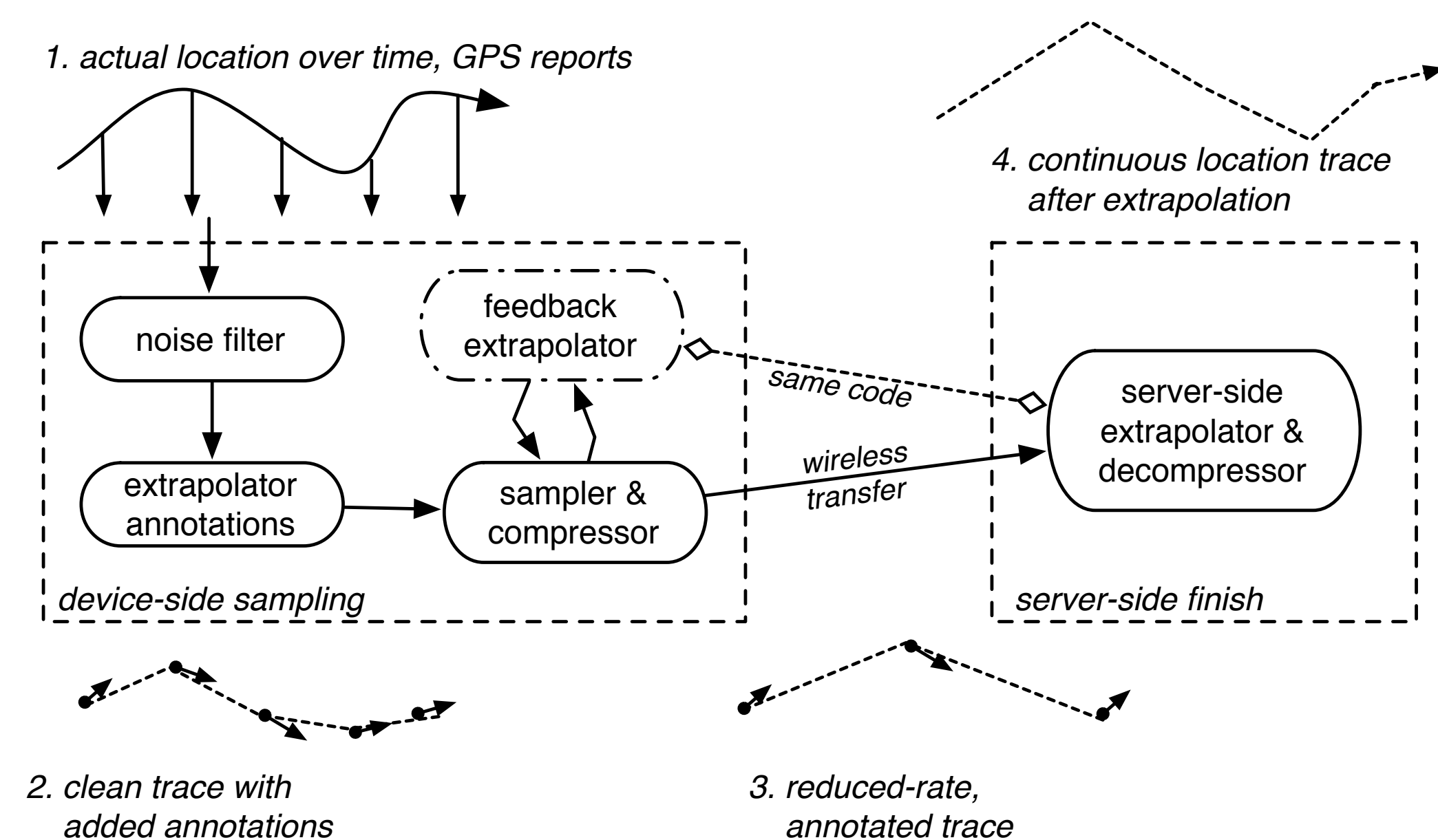
James Biagioni, A.B.M. Musa and Jakob Eriksson

University of Illinois at Chicago, Department of Computer Science

Introduction

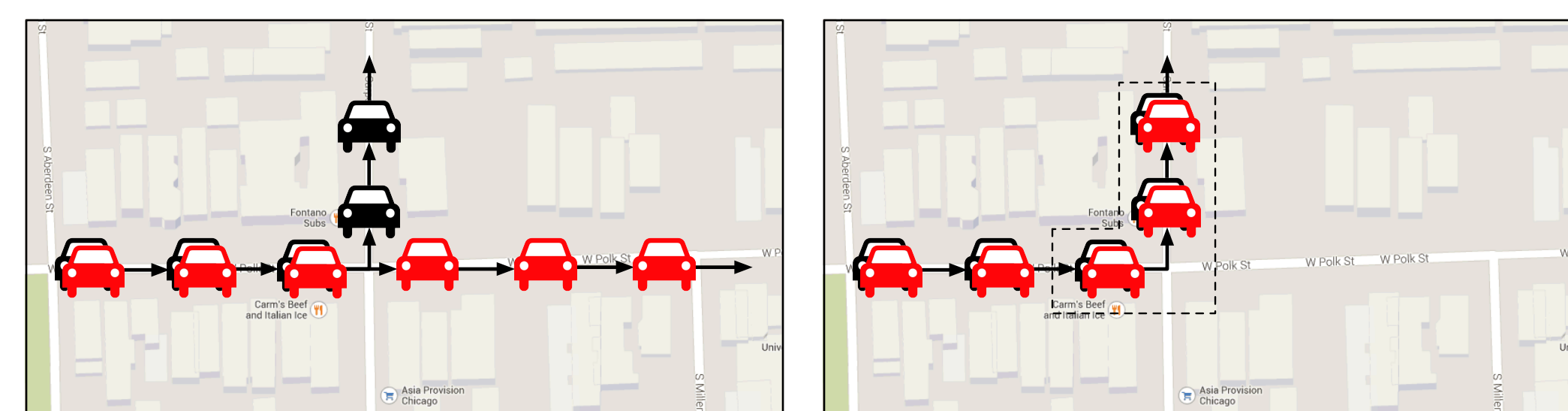
In this project we look at online GPS tracking, where a device reports its location in real-time to a central server over a cellular uplink. More specifically, we propose a *thrifty tracking* system that allows the specification of an error or budget-bound while it automatically optimizes the other, resulting in substantial error or cost savings.

A Thriftier Solution!

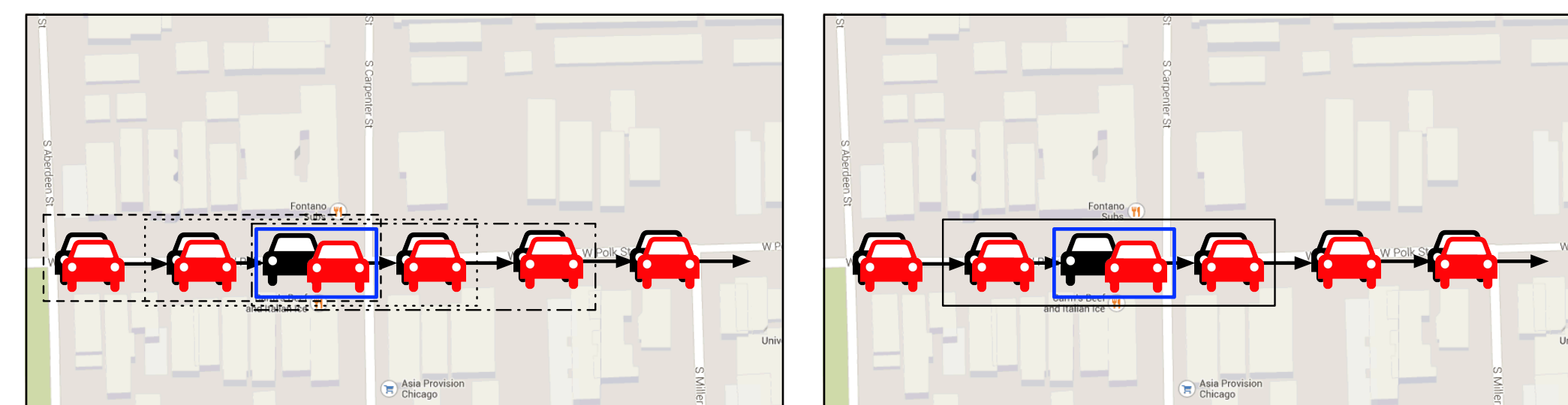


Adaptive Sampling

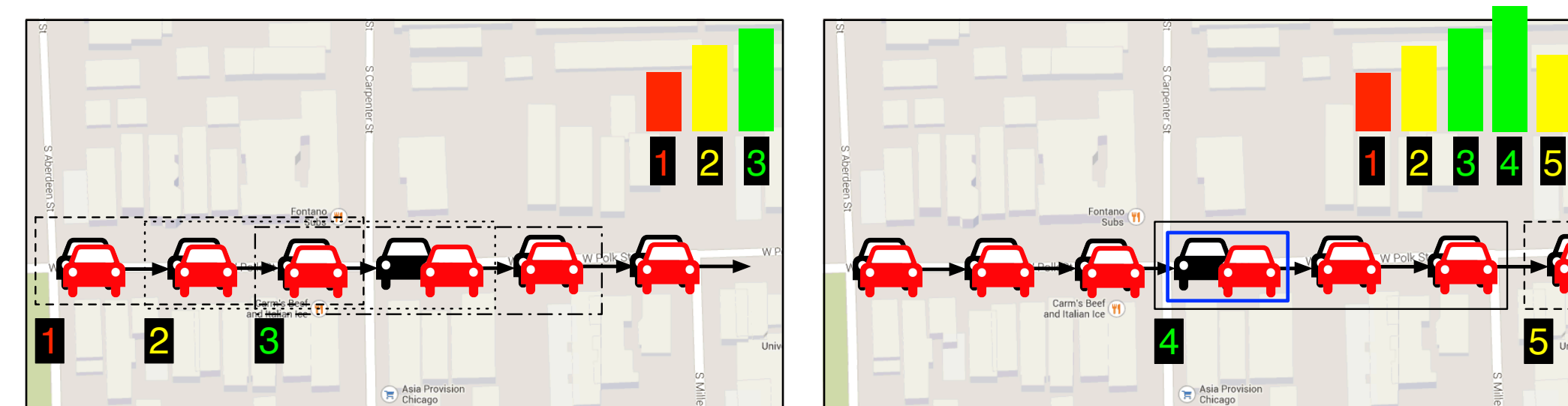
By comparing the current location against the extrapolator output and carefully deciding which samples to transmit we can achieve even greater performance gains. Given a fixed delay in reporting we can also flexibly choose when to transmit a sample and apply GPS trace compression.



With a fixed error-bound we minimize data usage.

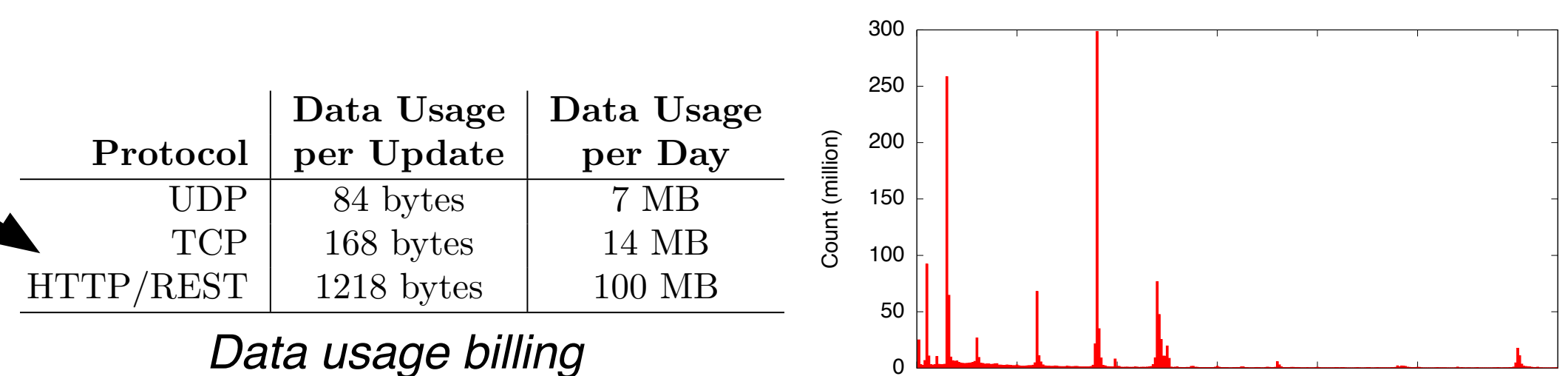


With a fixed budget-bound we minimize error.



State of the Practice

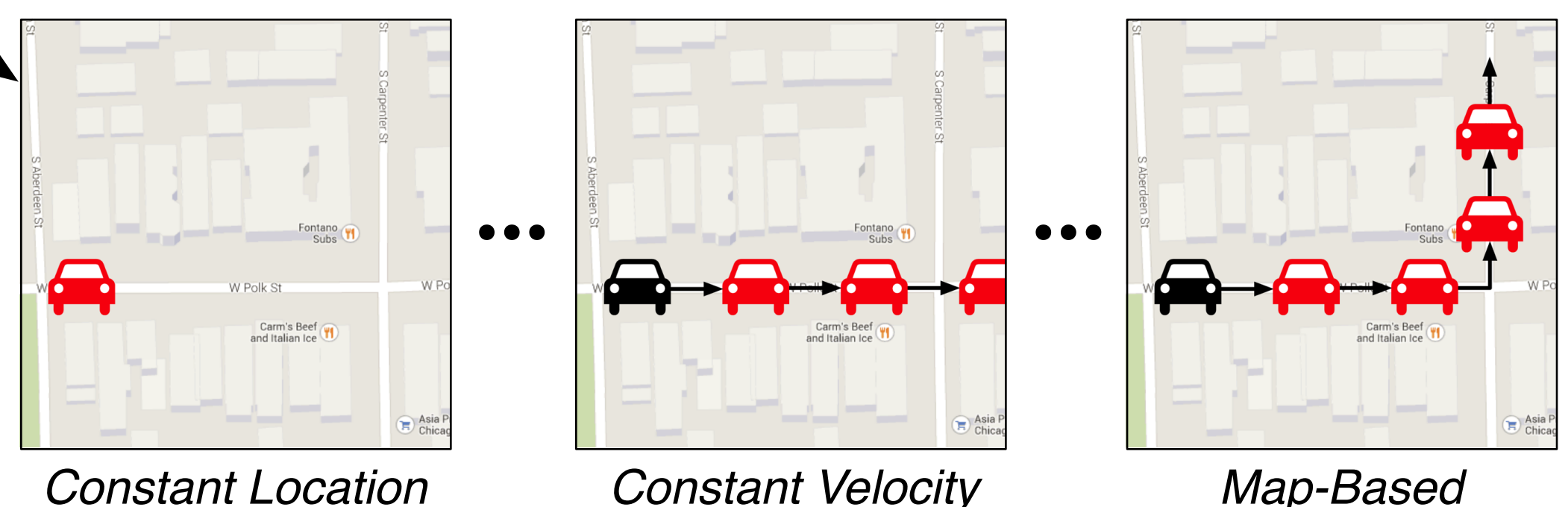
In our experiments with AT&T's wireless network we found that cellular data usage charges include significant overhead depending on the protocol being used.



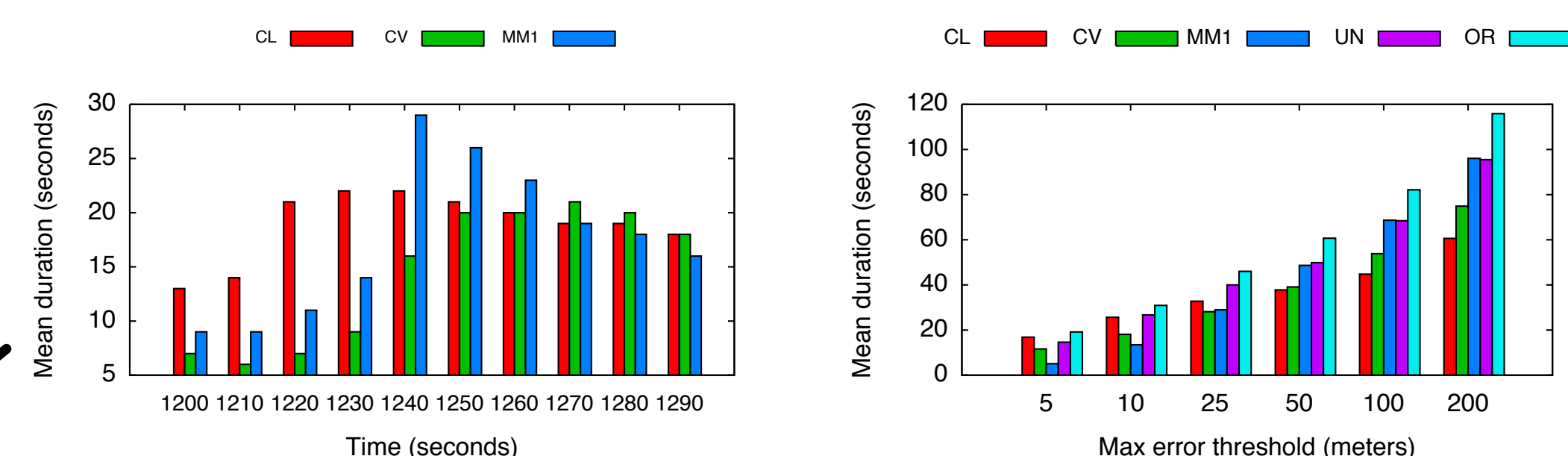
But no one seems to have noticed! In our field study of 1.6 billion GPS points from 25 data providers we found uniform periodic sampling to be the policy of choice.

Unified Extrapolation

If we can successfully predict the future location of a device, improvements can be made to both the timeliness and accuracy of tracking. To this end, we explored several standard extrapolation techniques.

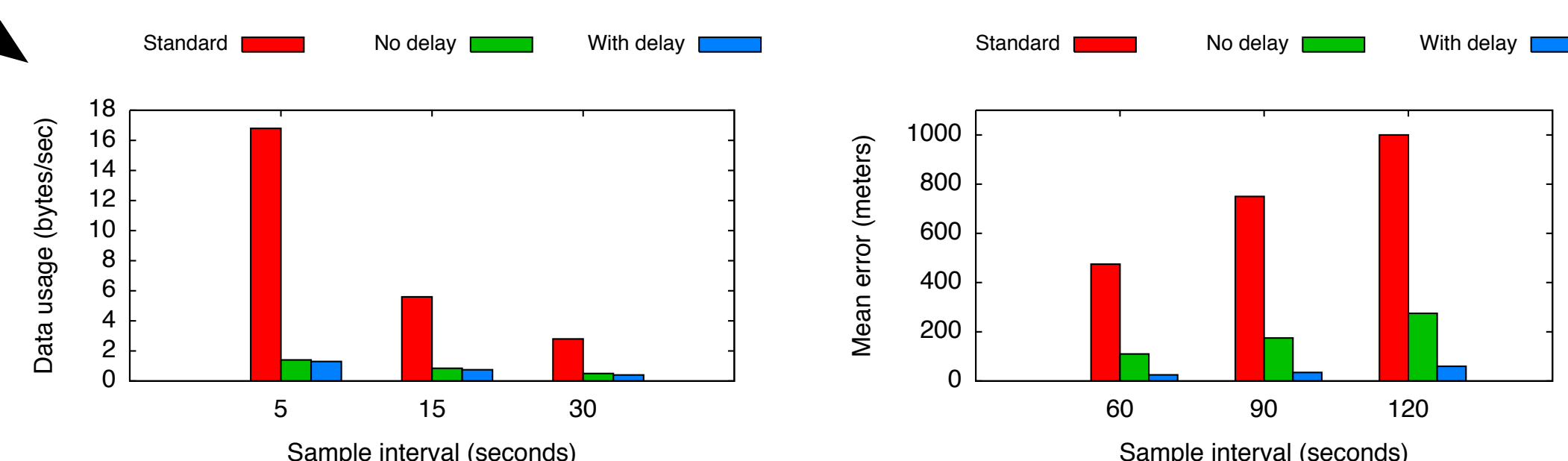


However, we discovered that no single method always works best. So we combined these techniques into a unified framework that automatically selects the best method given the current circumstances.



End-to-End Evaluation

We combined our unified extrapolator and adaptive sampler into an end-to-end system and compared its performance against *standard* tracking systems.



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