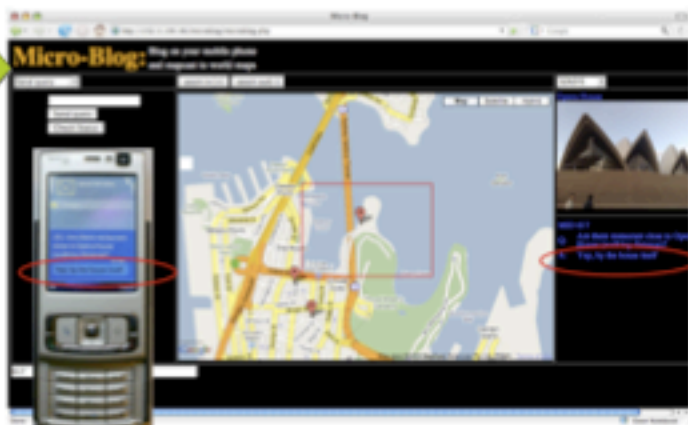


# Energy-Aware Localization Using Mobile Phones

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## Goals

- ❖ **Mobiles need localization:**  
Context aware search (e.g., **Micro-Blog**)  
Location based routing  
Geocasting, geotagging, driving directions, ...
- ❖ **Many direct methods available:**  
GPS, AGPS, ...  
GSM based triangulation  
WiFi fingerprinting
- ❖ **Tradeoff between energy & localization**



Nokia	GPS		WiFi		GSM	
Sampling Period	30s	60s	30s	60s	30s	60s
Battery Life (hours)	<b>8:30</b>	8:45	17:30	26:55	25:00	29:15
Accuracy (meters)		~5m	~75m		~500m	

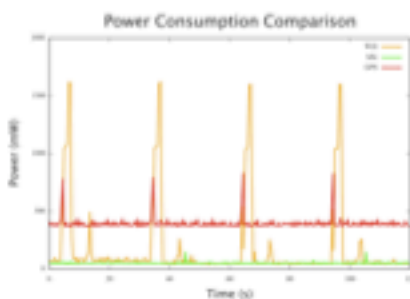
Less than **10 hours** battery for constant GPS

Acceptable battery life  
But **unacceptable accuracy**

## Problem Definition

Can we achieve the best of both worlds?  
**Long Battery Life and High Accuracy**

Recorded **live** power data  
250mS period  
~10mA accuracy  
over 1 week of data



GPS, 802.11, Idle Power



## Analysis Framework

For a given mobility trace (all sensors)  
Determine **optimal sampling schedule** for a **given energy budget**

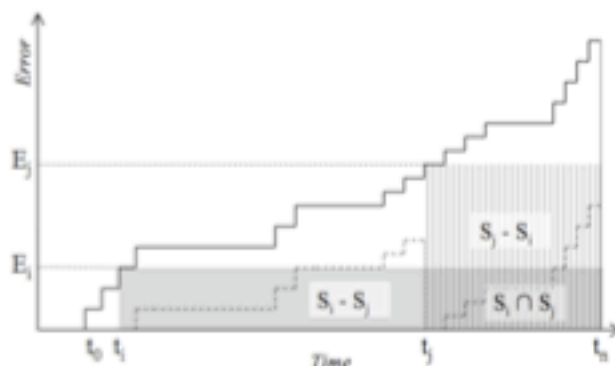
- Using dynamic programming
- Obtain upper and lower bounds

Compare with proposed hybrid methods

1D movement dynamic program

$$P(j, K) = \max_i \{P(i, K-1) + S(i, j)\}, \quad i < j, \quad (1)$$

$$P(i, 1) = \text{area of rectangle } i \quad (2)$$



## Ongoing Work

- ❖ **Collect additional mobility traces**
- ❖ **Evaluate various strategies**  
Regression and prediction  
User's mobility profile  
Accelerometer to detect movement and activity