Introduction – “Trade-off position accuracy for energy”

Problem
- Many emerging smartphone applications require position information to provide location-based or context-aware services.
- GPS is preferred over GSM/WiFi based methods, but GPS is extremely power hungry.
- Fixed interval periodic duty cycling will not solve the problem; it may have significant error without significant energy benefits.

Goal
- Reduce the amount of energy spent by the positioning system while still providing sufficiently accurate position information.
- Trade-off position accuracy for reduced energy.

RAPS: Rate-Adaptive Positioning System
- An energy-efficient positioning system that adaptively duty-cycle GPS only as often as necessary to achieve required accuracy based on user mobility and environment.

Observations and Challenges – “GPS is less accurate in urban areas”

GPS is less accurate in urban areas
- Accelerometer and Bluetooth consume less energy than GPS, if used cleverly

Periodic duty-cycling is not good enough
- Cell-tower and RSS data cannot reliably measure user movement, but can detect GPS unavailability

Design and Evaluation – “RAPS: Rate-Adaptive Positioning System”

Design and Approach
- Movement Detection
  - Use duty-cycled accelerometer with onset detection algorithm to efficiently measure the activity ratio of the user.
- Velocity Estimation
  - Use space-time history of the past user movements along with their associated activity ratio to estimate current user velocity.
- Unavailability Detection
  - Use celltower-RSS blacklisting to detect GPS unavailability (e.g., indoors) and avoid turning on GPS in these places.
- Position Synchronization
  - Utilize Bluetooth-based position synchronization to communicate and reduce position uncertainty among neighboring devices.

Evaluation Results – promising!!
- RAPS reduced energy consumption by 48% over fixed duty-cycles with comparable accuracy
- Cell-tower-RSS blacklisting and activity ratio scheme contributes to energy saving
- Bluetooth synchronization has potential benefits (43% in this example)