Sensor Assisted Wireless Communications

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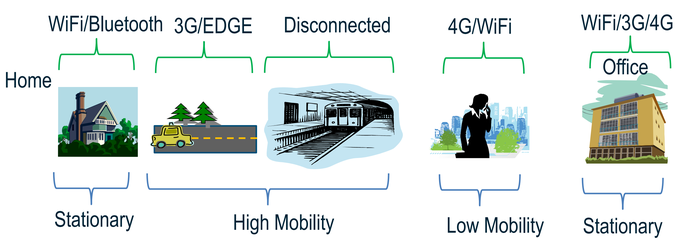
Mobility Demands Agility

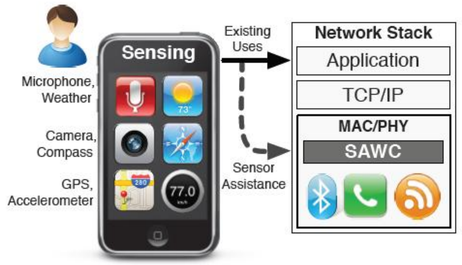
- ❑ Mobile devices always on, always with users
  - Devices subjected to continuous mobility
  - Users expect seamlessness, context-awareness



- ❑ Wireless context assessment
  - Hard/expensive, especially in-band
  - Ex: When will train come to station (to enable WiFi) ?
- ❑ High overhead with in-band sensing
  - Wireless systems usually optimized for single setting
  - Not agile enough for diverse environments

Sensor Assistance for Wireless Communication

- ❑ Break away from in-band assessment
- ❑ Mobile phones equipped with multiple sensors
  - Offer multi-dimensional out-of-band information
- ❑ Exploit out-of-band information to assess context
  - Make communication context-aware

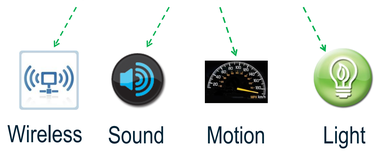


Why Out-of-Band Sensing?

- ❑ Context-aware applications using sensor hints exist
  - Ex: Display off when talking

- ❑ Sensor hints for *wireless*
  - Relatively unexplored

Contexts have fingerprints across multiple sensing dimensions



Diversity improves context discrimination

In-band sensing unable to leverage diversity

Case Study 1: MW-aware Channel Switching

- ❑ Micro Wave (MW) ovens operate at 2.4GHz
  - Interfere with WiFi; transmitters carrier sense
  - Throughput degrades due to interference and backoff

Out-of-band approach: Sense microwave "hum" and switch channel

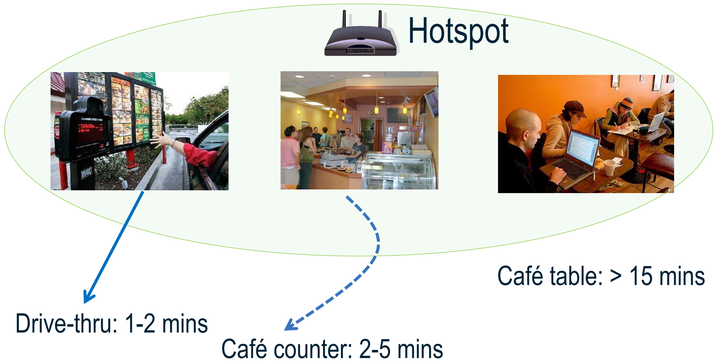
Case Study 2: Activity-aware Communication

Accelerometer detects user is driving

Phone checks with caller if call can be postponed

Case Study 3: Offloading 3G

- ❑ Desirable to offload traffic from 3G to WiFi
- ❑ Use sensors to predict if user is likely to exit soon
- ❑ Prioritize soon-to-leave users over WiFi
  - More data on WiFi ➔ Less carry over to 3G



- ❑ AP runs machine learning algorithm
  - Classifies behavior into "dwell time" buckets
- ❑ Traffic prioritization at AP based on dwell time

Discussions and Ongoing Work

- ❑ Out-of-band should provide timely context
- ❑ Overhead should be minimal
  - Sensor cost amortized over many applications
- ❑ Focus of current work
  - Identifying suitable applications & out-of-band channels
- ❑ Complementary to in-band sensing
  - Treat SAWC as hint rather than solution

Out-of-band information provides useful hints: Potential to enhance wireless communications