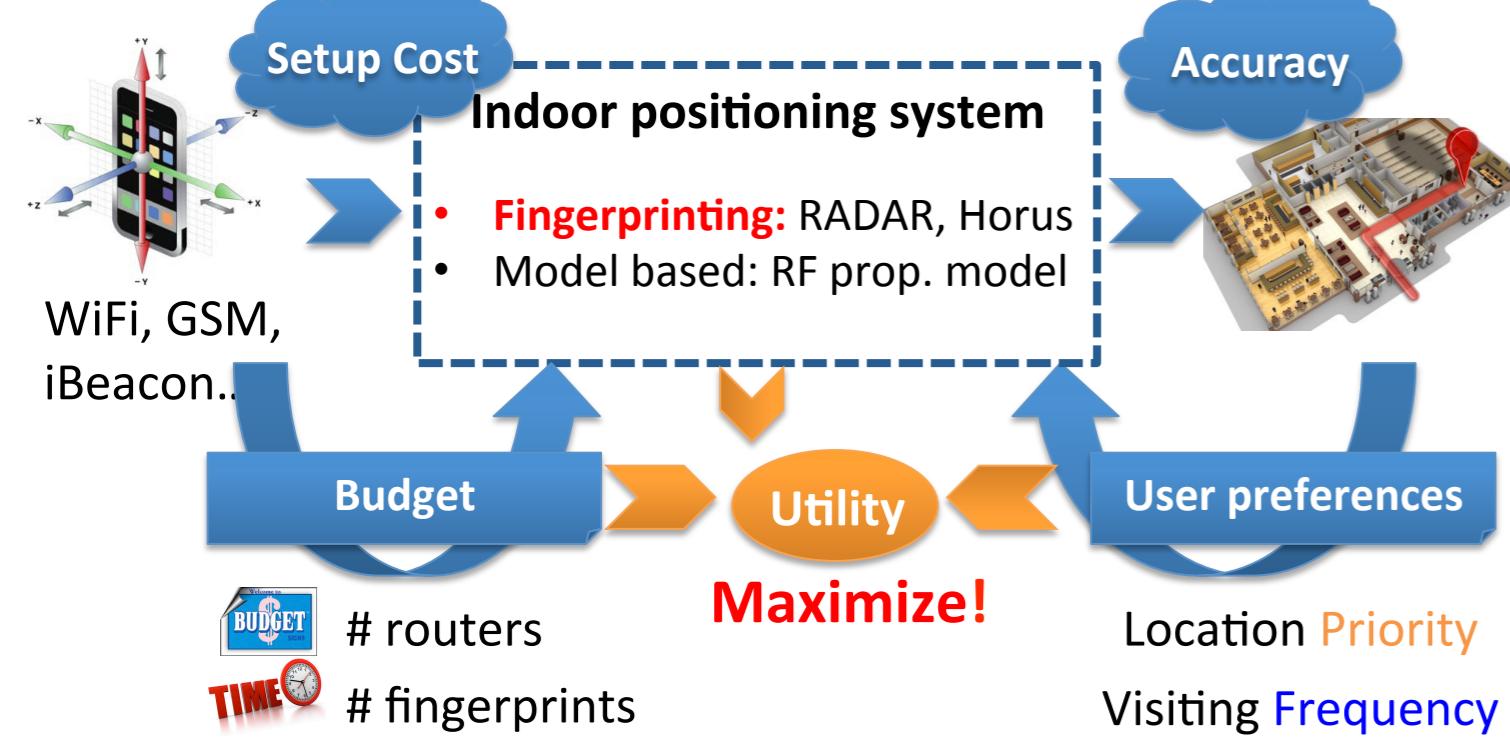




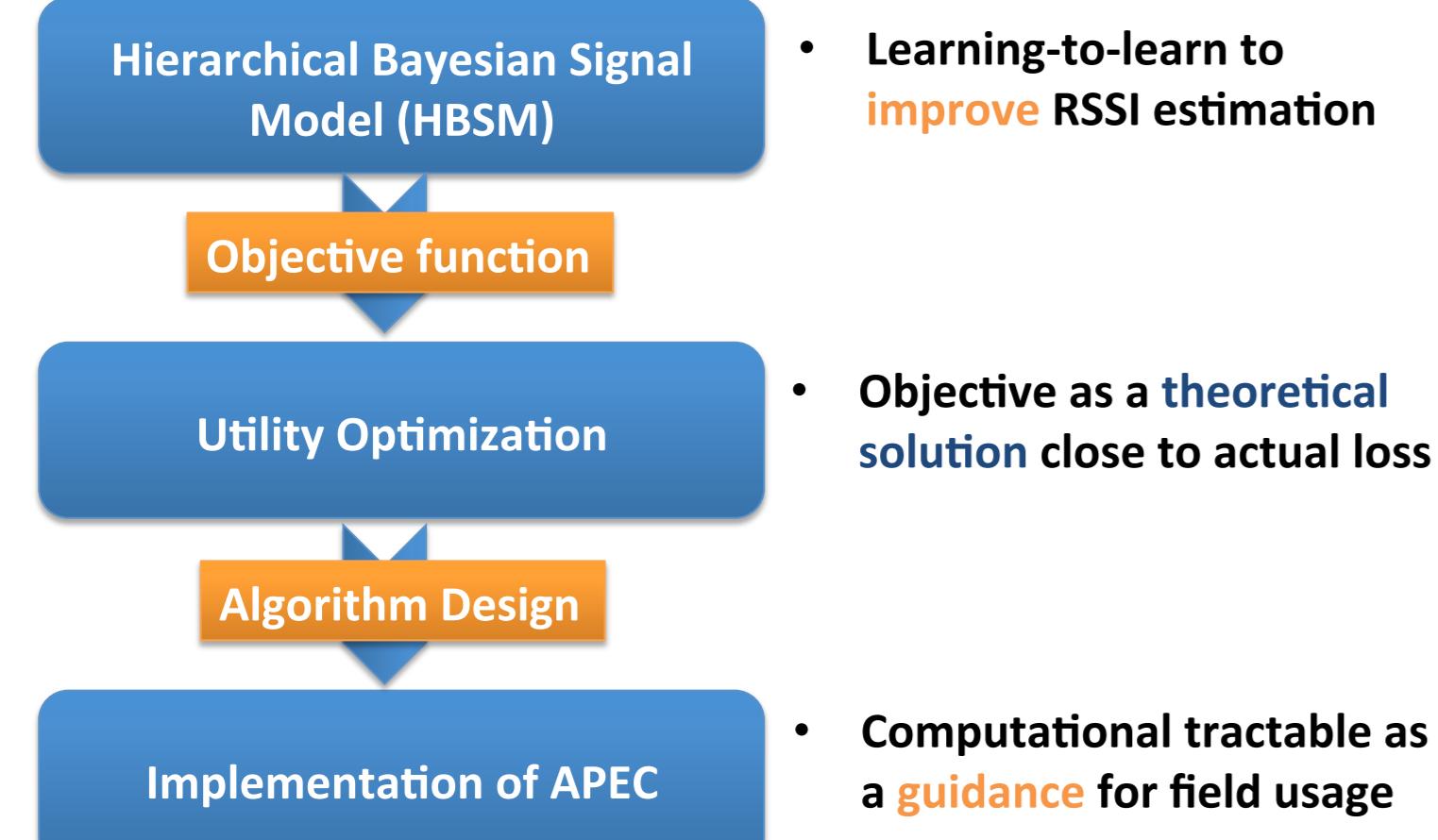
APEC: Auto Planner for Efficient Configuration of Indoor Positioning Systems

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Introduction and Contribution



APEC: design the fingerprints-based IPS that accounts for **user preferences** and **budget constraints**



Optimization Framework

$$\begin{aligned} & \underset{\theta}{\text{minimize}} \quad L(Z, h_{\theta}(X)) = c_Z P_Z(h_{\theta}(X) \neq Z) \\ & \text{subject to} \quad \theta = \{\theta^{fp}, \theta^{rt}\} \in \Theta \end{aligned}$$

1 $L(Z, h_{\theta}(X)) = c_Z P_Z(h_{\theta}(X) \neq Z)$
2 Expectation over visiting freq. $\mathbb{E}_{Z \sim P_Z, X \sim P_{X|Z}}$
3 HBSM randomness
4 Number/location of routers/fingerprints

APEC Algorithm

Minimization of the expected loss:

$$\mathbb{E}_{Z \sim P_Z, X \sim P_{X|Z}} L(Z, h_{\theta}(X)) = \sum_{i \in [N]} \pi_i \sum_{j \in R(i)} c_i P_i(h_{\theta}(x) = j)$$

Priority Misclassification rate
Weighted cost of location confusion

Tasks:

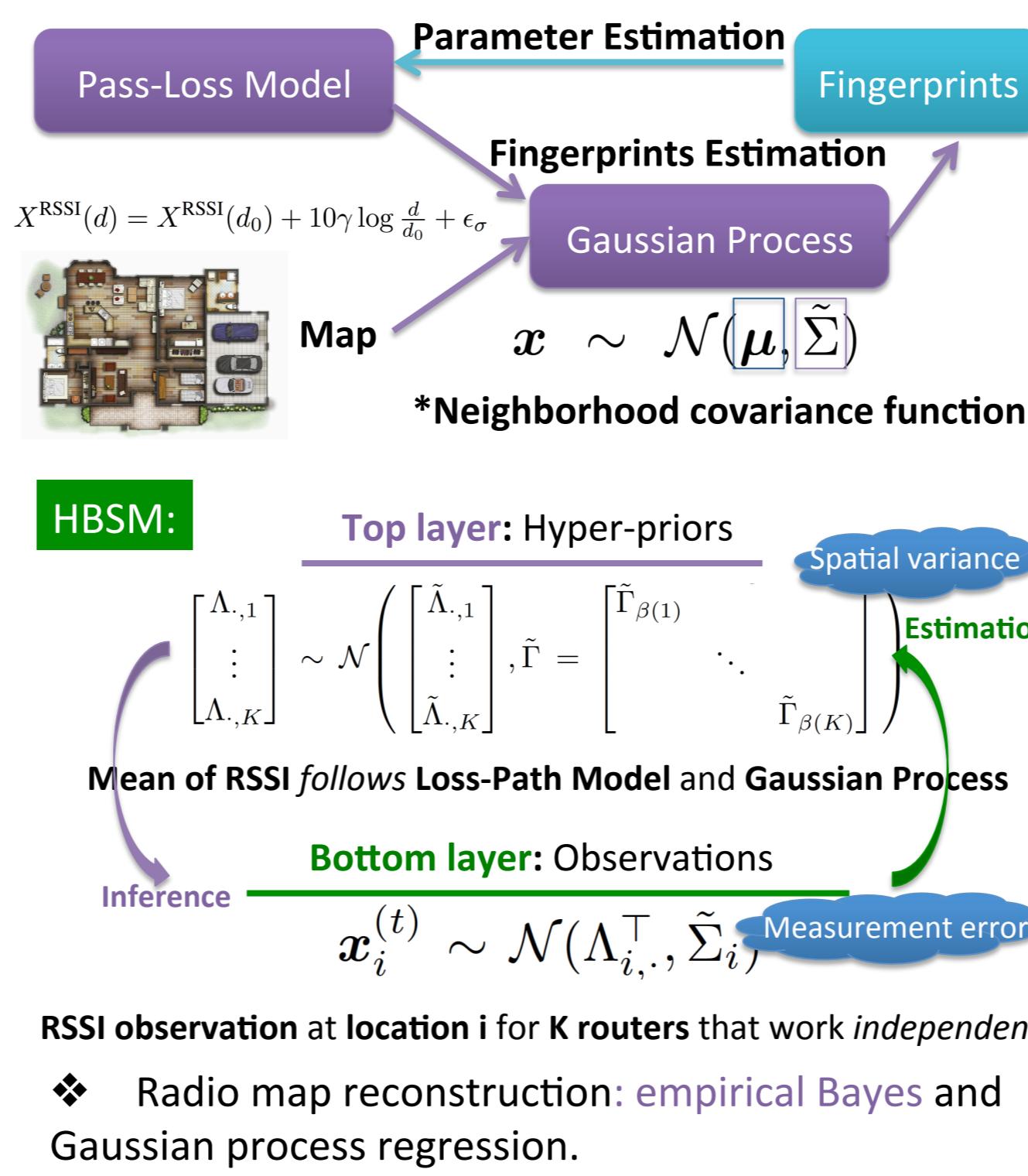
- ❖ θ^{rt} (router locations): Given M possible locations, choose K to place the routers.
- ❖ θ^{fp} (fingerprints): Distribute the number of fingerprints to be collected.

Strategies:

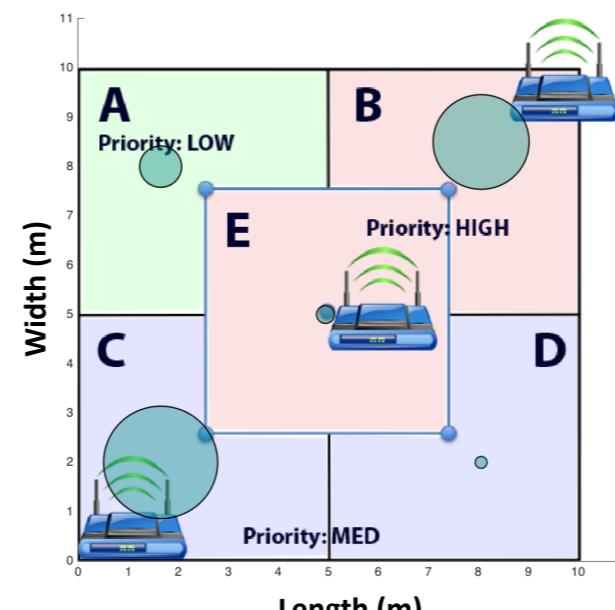
- ❖ Exhaustive: search all possible router/fingerprints combinations (intractable!)
- ❖ Greedy: stochastically optimize through coordinate descent (heuristic!)

Hierarchical Bayesian Signal Model (HBSM)

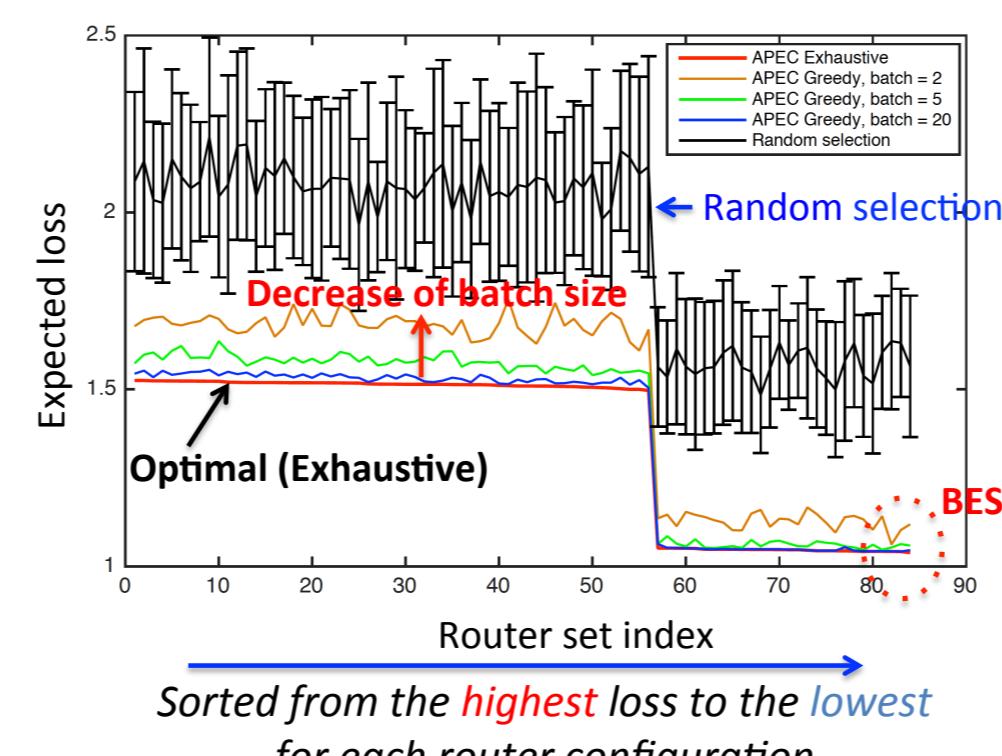
How can we make efficient use of fingerprints?



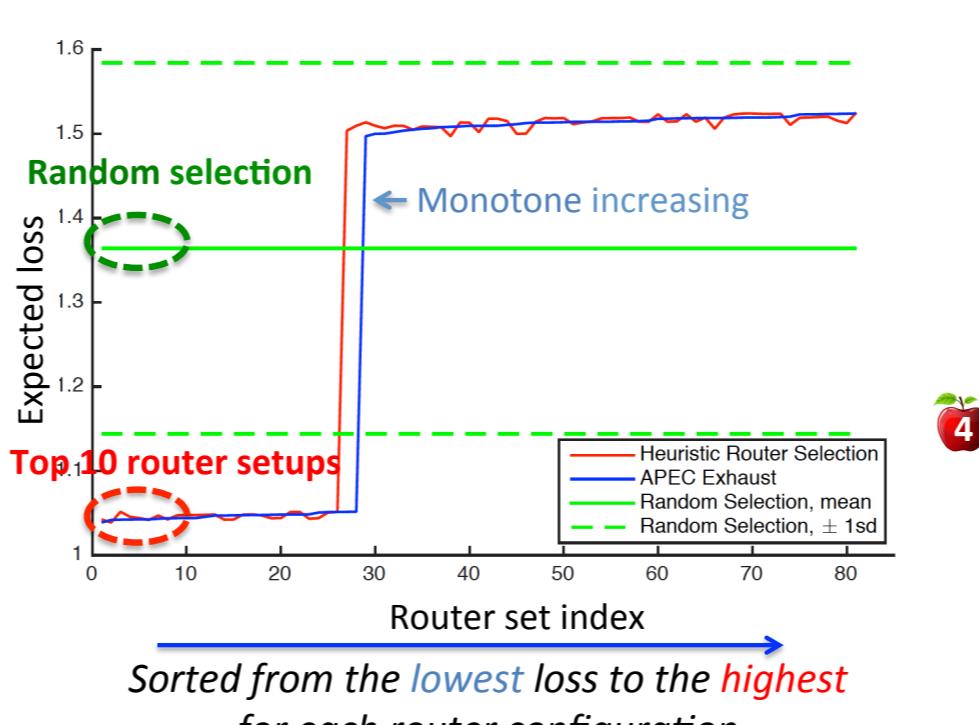
Toy Case Study



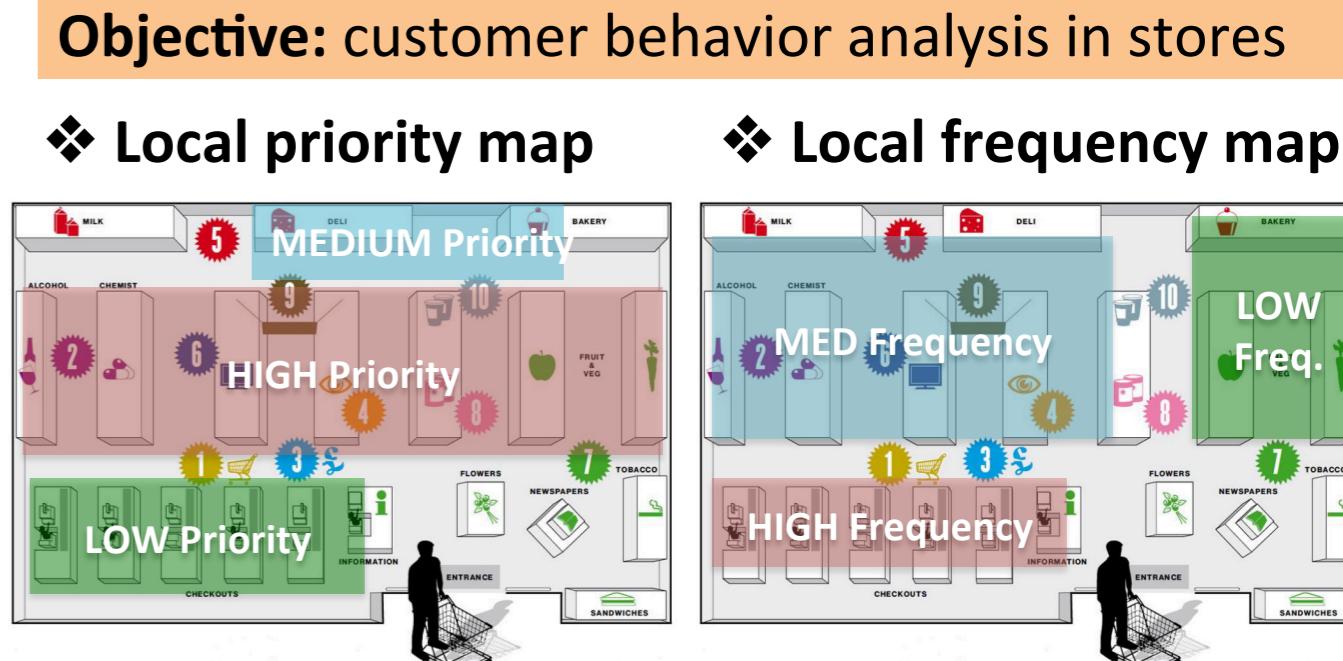
Heuristic 1: increment the number of firs at many random batches of locations and choose the best



Heuristic 2: router locations can be chosen assuming uniform fingerprints allocation



User Preferences

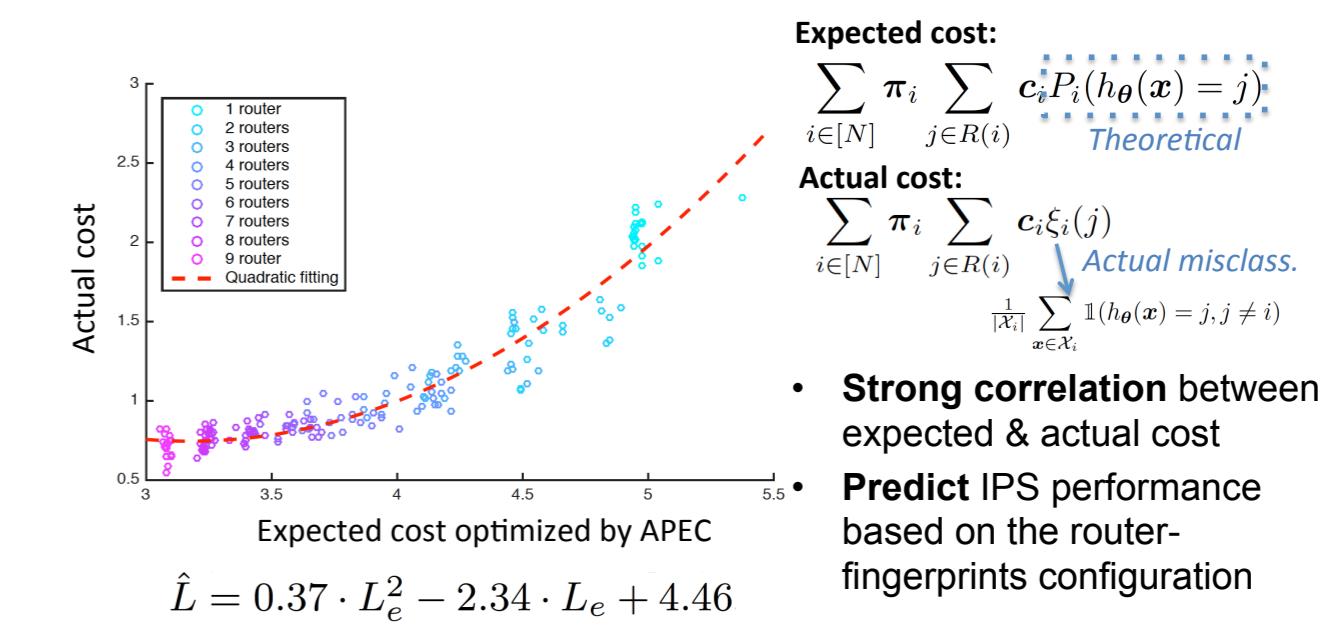


Field Deployment

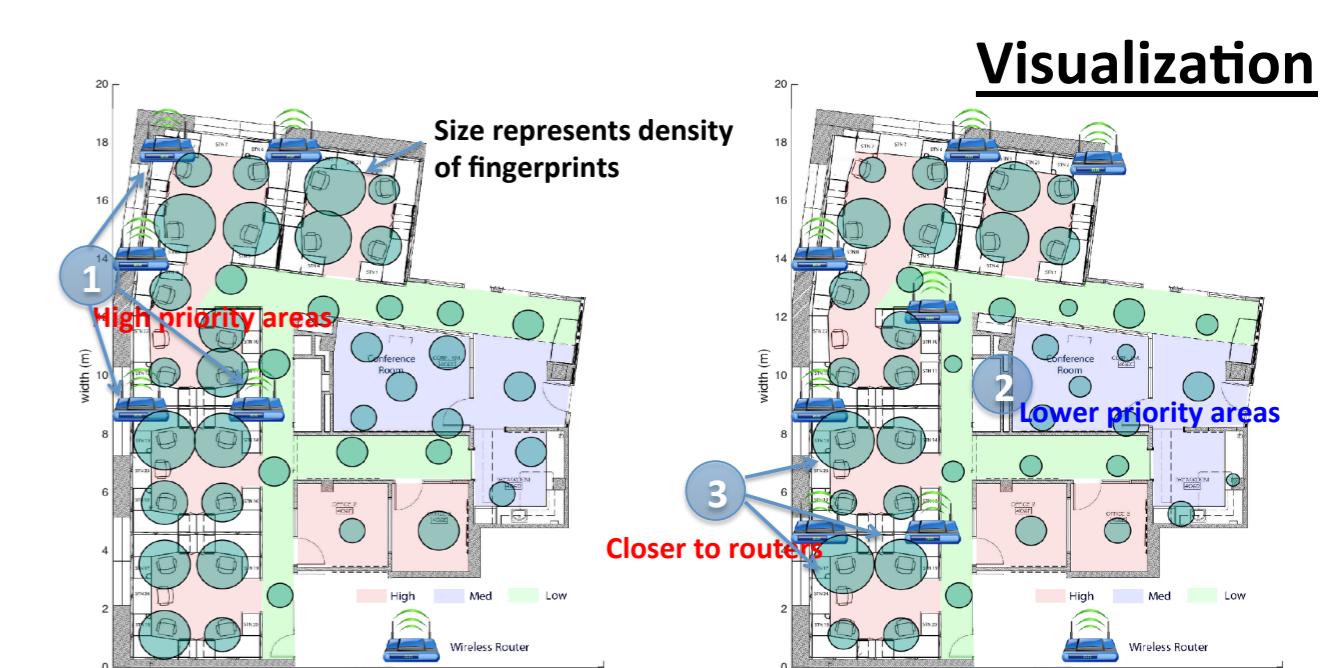
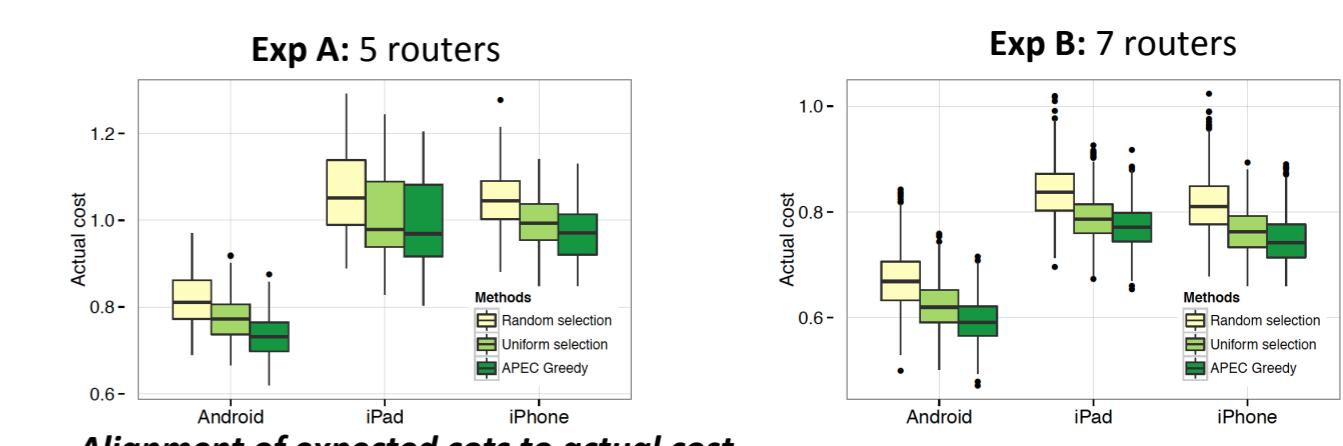


- HIGH Priority for cubicles: automatic climate control
- MED Priority for shared spaces: energy apportionment
- LOW Priority for corridors

Hypothesis 1: the expected cost is a good indicator of the actual cost of the system



Hypothesis 2: APEC Greedy performs well for the actual cost of the system (solution superiority)



Conclusion and Future

- ❖ APEC: systematically optimizes the locations of APs and fingerprints
- ❖ Implement and visualize APEC configuration on mobile platforms

Publication: APEC: Auto Planner for Efficient Configuration of Indoor Positioning Systems, 9th International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies, 2015