A Framework for Protecting Worker Location Privacy in Spatial Crowdsourcing

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Spatial Crowdsourcing

Ubiquity of mobile users

6.5 billion mobile subscriptions by the end of 2013

≡ 93% of the world population

Technology advances on mobile phones (e.g., Cameras)

Network bandwidth improvements

Spatial crowdsourcing (SC) engages individuals, groups, and communities in the act of collecting, analyzing, and disseminating urban, social, and other spatiotemporal information.

Applications

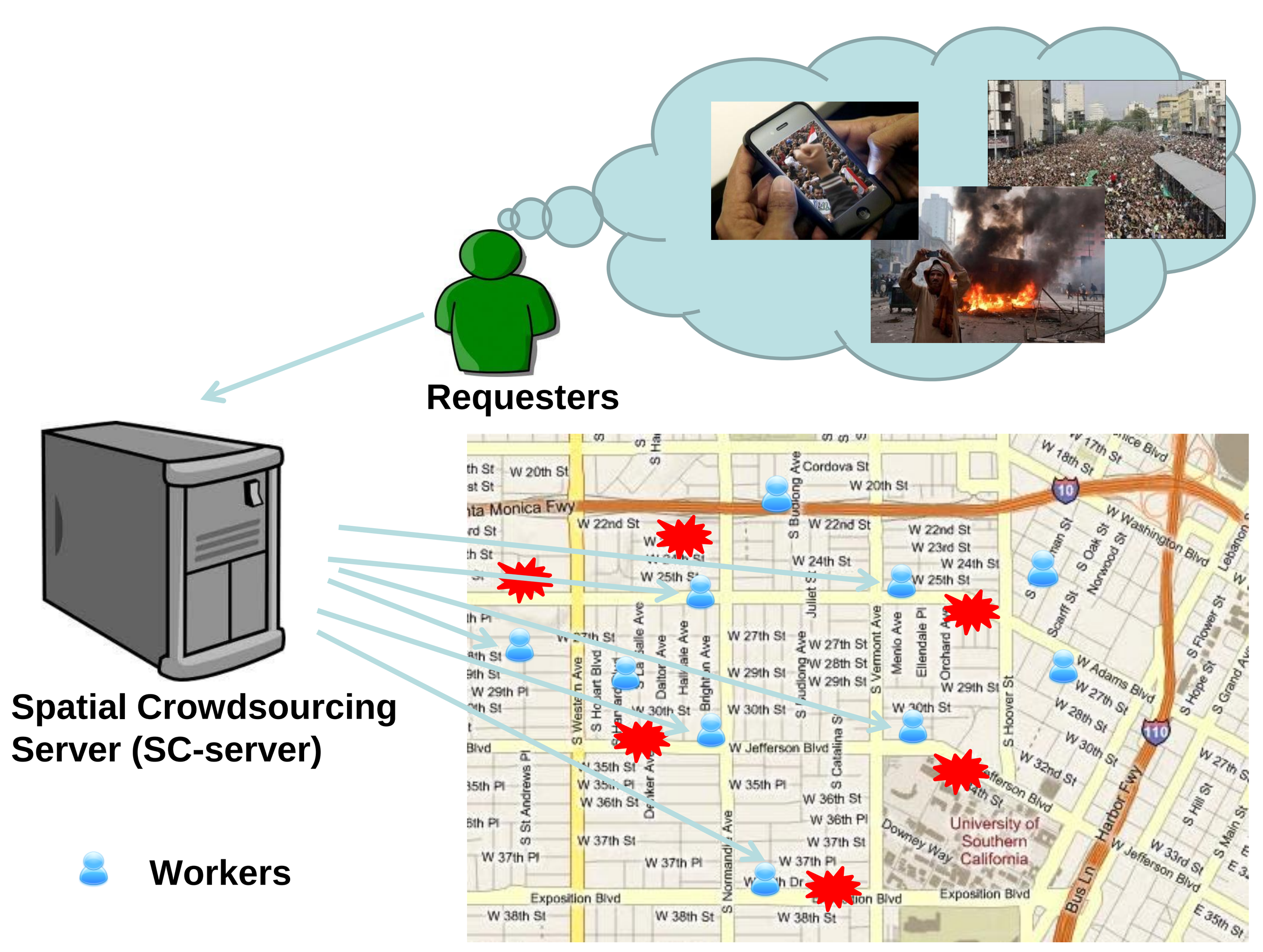
Spatial crowdsourcing has applications in numerous domains such as journalism, tourism, intelligence, disaster response and urban planning.

In the following disaster-response scenario, where Red Cross (i.e., requester) is interested in collecting pictures and videos of disaster areas from various locations of a city.

+ The requester issues a query to a SC-server

+ The SC-server crowdsources the query among the available workers in the vicinity of the events

+ Once the workers document their events with their mobile phones, the results are sent back to the requester



Challenges

Location privacy is one of the major impediments that may hinder workers from participation in SC.

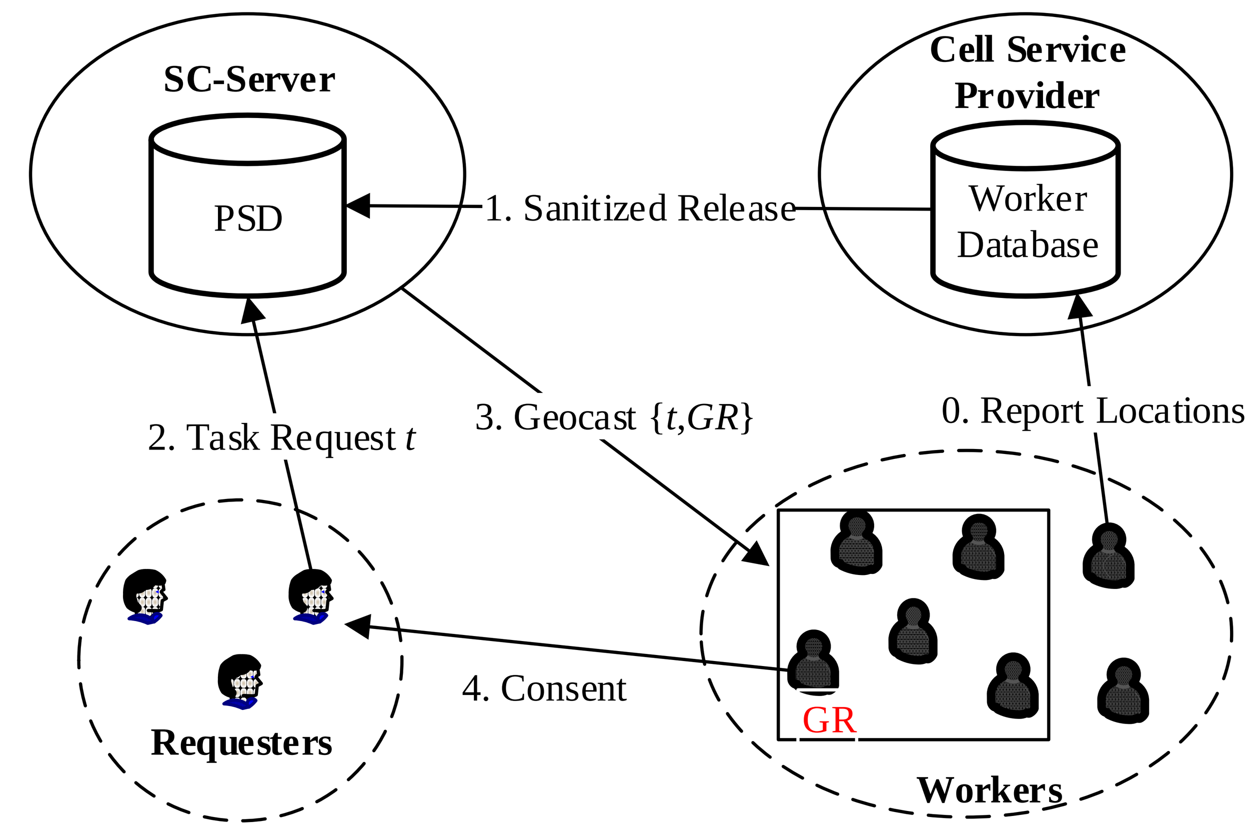
Current solutions require the workers to disclose their locations to untrustworthy entities, i.e., SC-server.

Need a framework where the SC-server only has access to sanitized data.

Existing location privacy techniques are not sufficient. Worker locations are not part of the query but rather the result of a spatial query around the task location.

Privacy Framework

Our framework achieves *differential privacy* guarantees.



Proposed Techniques

Customized Adaptive Grid: finds appropriate PSD partitions to reduce system overhead (i.e., communication and computation cost).

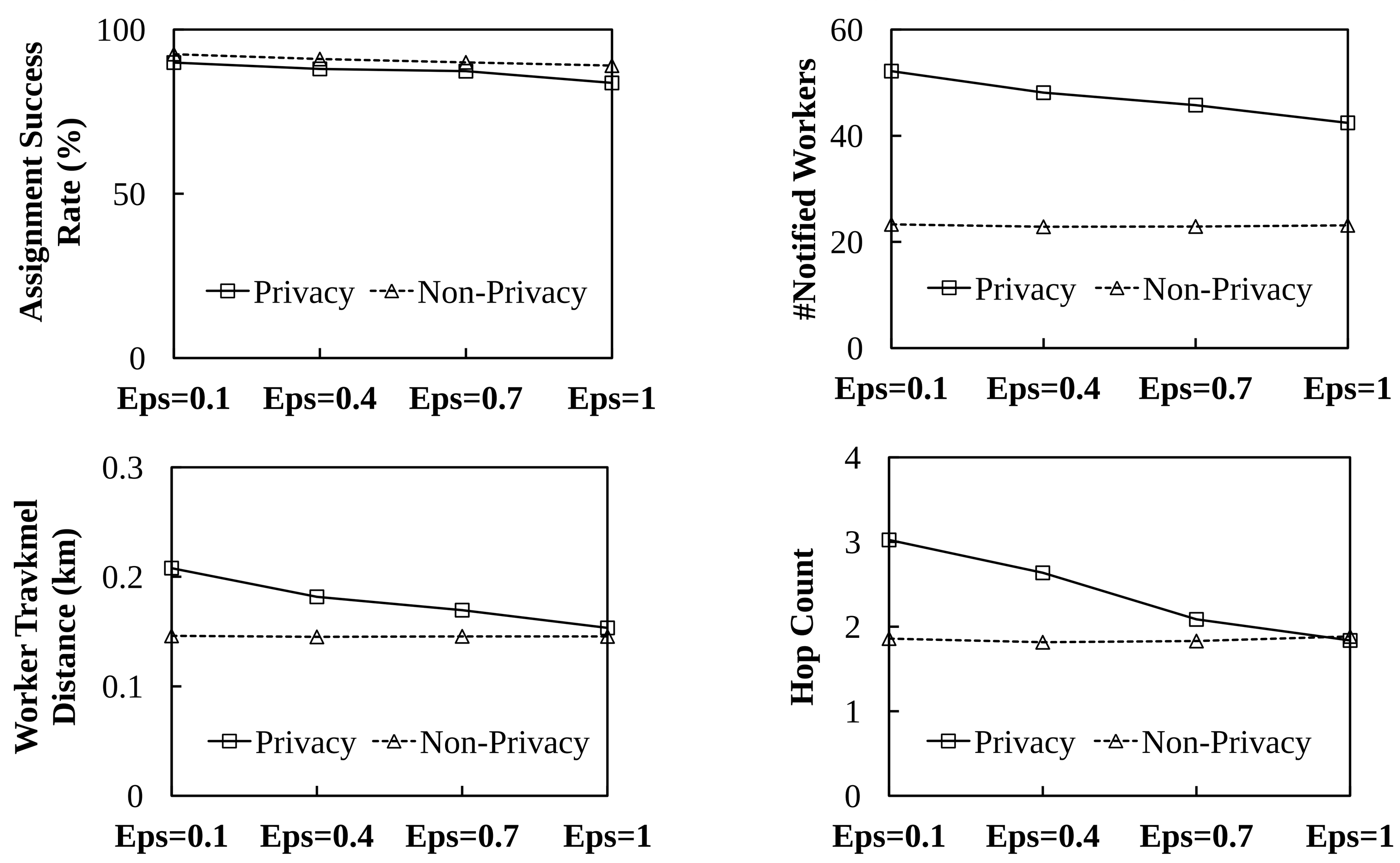
Analytical Utility Model: measures the probability of task completion with uncertain worker locations.

Geocast Region Construction: devises a utility-based search strategy that ensures high success rate of task assignment.

Search Strategy Refinements: 1) investigates finer-grained search by allowing partial cell inclusion and 2) considers the effect of GR shape (i.e., *compactness*) on hop-by-hop task request communication. Both improvements reduce communication cost.

Experiments

Overhead of achieving privacy by varying privacy budget, Eps



Conclusion: the proposed techniques are effective and the cost of privacy is practical

Future Work

❖Extend our framework to the case where privacy of both workers and tasks needs to be protected.

❖Address PSD in the context of multiple time snapshots.

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IMSC Integrated Media Systems Center