A Generic Framework for *Spatial Crowdsourcing*

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Spatial Crowdsourcing

Crowdsourcing: outsourcing a set of tasks to a set of workers. amazon mechanical turk™ Artificial Artificial Intelligence

Spatial crowdsourcing (SC)*:* requires workers to ***physically*** travel at the task's location in order to execute the task.

SC Applications

Ubiquity of mobile users ← **6.5 billion** mobile subscriptions, 93.5% of the world population [1]

Technology advances on mobiles ← Smartphone's **sensors**. e.g., video cameras

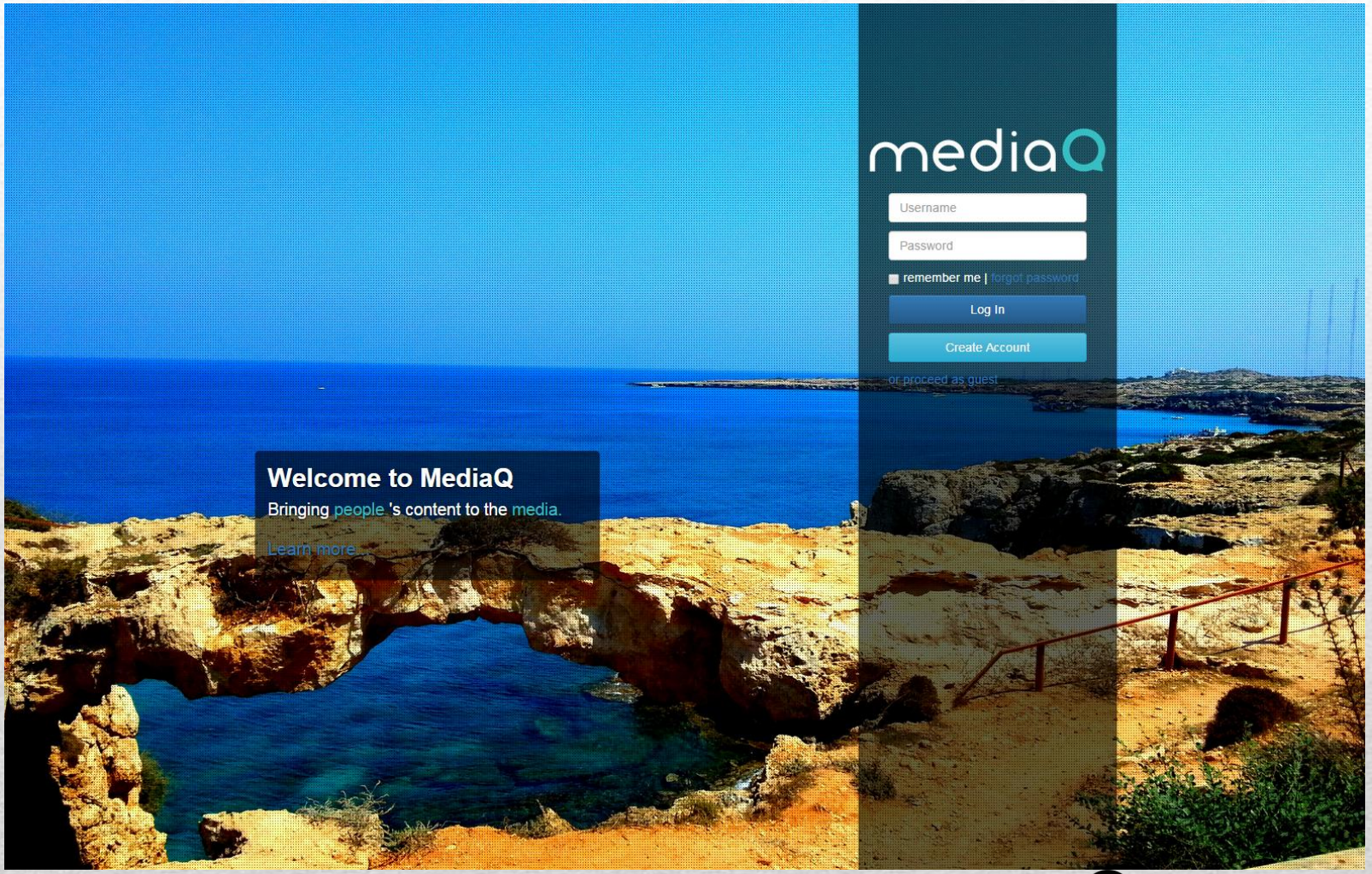
Network bandwidth improvements ← From 2.5G (up to 384Kbps) to 3G (up to 14.7Mbps) and recently **4G** (up to 100 Mbps)

[1] http://www.gartner.com/newsroom/id/2665715

MediaQ Demo

http://mediaq.usc.edu/

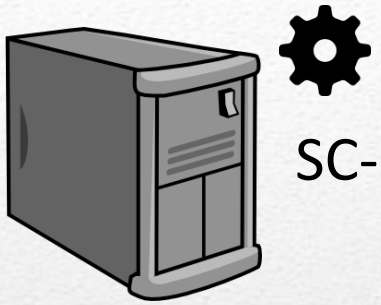
[Kim et.al MMSys'14]



MediaQ helped PBS cover the Presidential Inauguration on Jan. 20, 2013 PBS NEWSHOUR

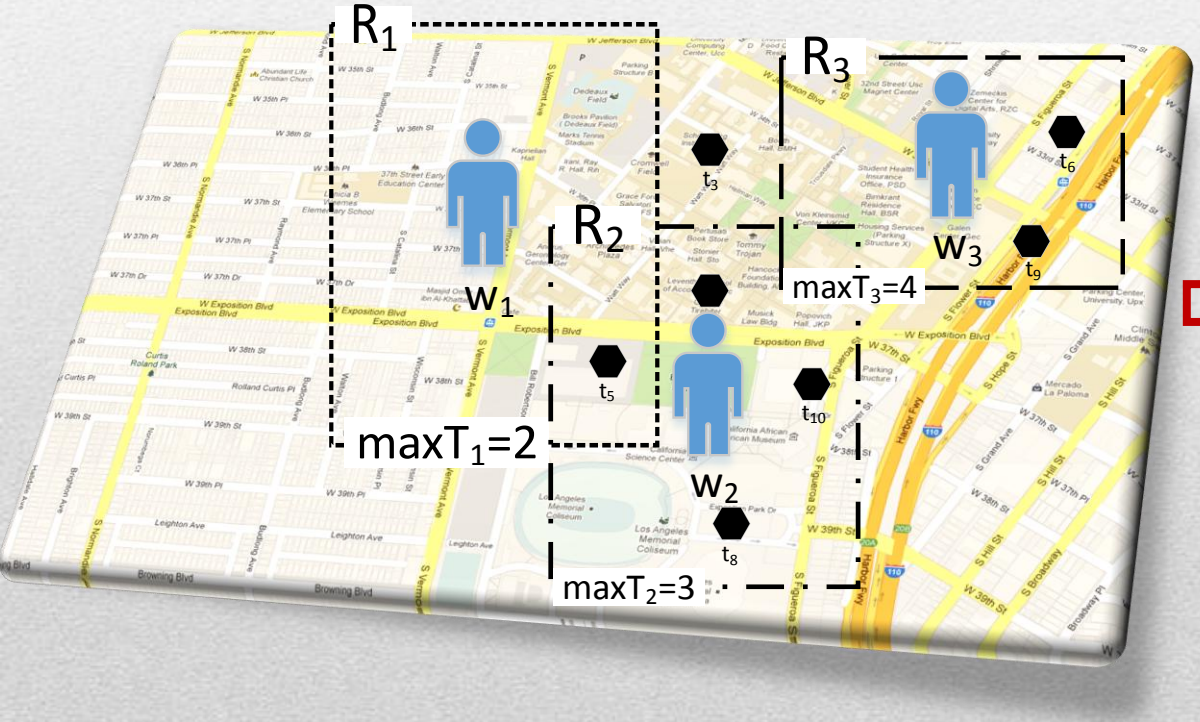
Task Assignment

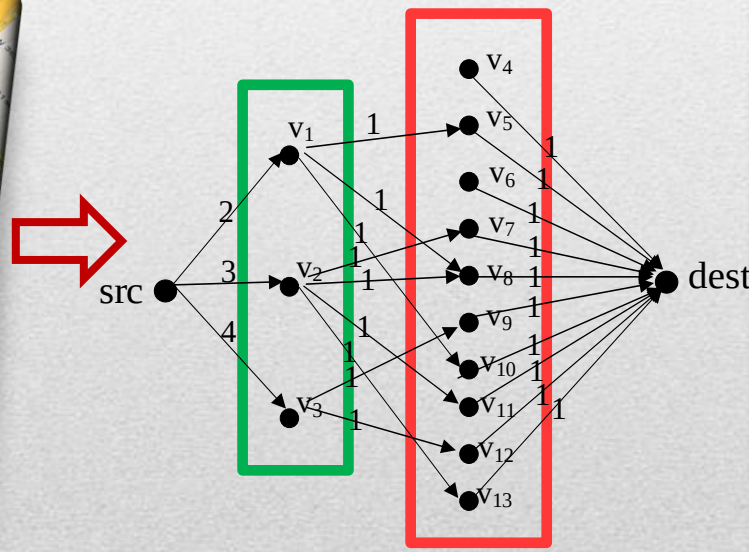
Requesters



SC-server

One time snapshot





[Kazemi et.al ACM GIS'12]

Maximum task assignment is reducible to max-flow problem

Challenges of Task-assignment

- **Dynamism**
  - Tasks/workers arrive **without** our knowledge
- **Location Privacy**
  - Adversary can infer workers' **sensitive details**
- **Trust**
  - Workers **cannot** always be trusted, i.e., malicious/spam users

Dynamic Task Assignment

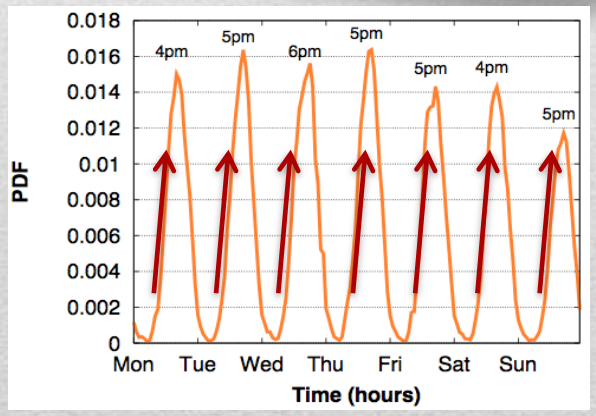
- **Local task assignment** at every time snapshot

- **Learn worker distribution**
  - Prefer tasks in **worker-sparse areas**
  - Prefer **nearby** workers

[To et.al TSAS'15]
[Kazemi et.al ACM GIS'12]

- **Learn activity patterns**
  - Defer tasks arriving in **uphill** periods

Submitted to [VLDB'15]

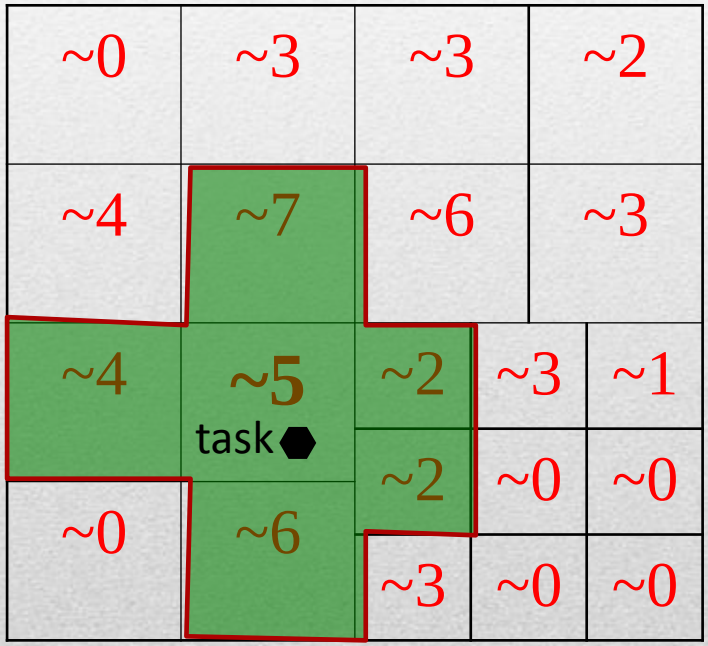


From [Musthag et.al CHI'13]

Worker Location Privacy

- **Objectives**
  - Assign tasks to workers **without** knowing workers' locations
  - Ensure tasks will be performed, with **high probability**
- **Solutions**
  - Assign every task to **all** workers
    - **Does not scale!**
  - Assign tasks to **sufficient nearby** workers
- **Differential Privacy**
  - Preserve privacy of individual workers

[To et.al VLDB'14]
[To et.al ICDE'15]

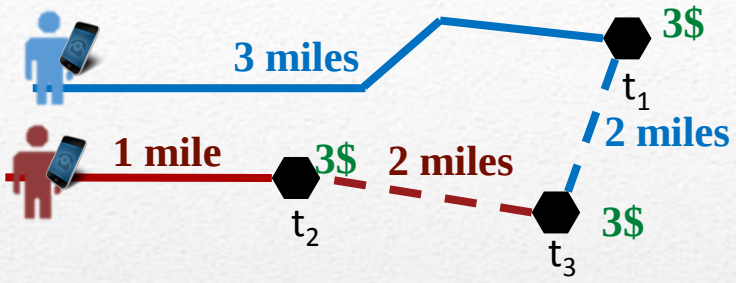


Noisy worker count per grid cell

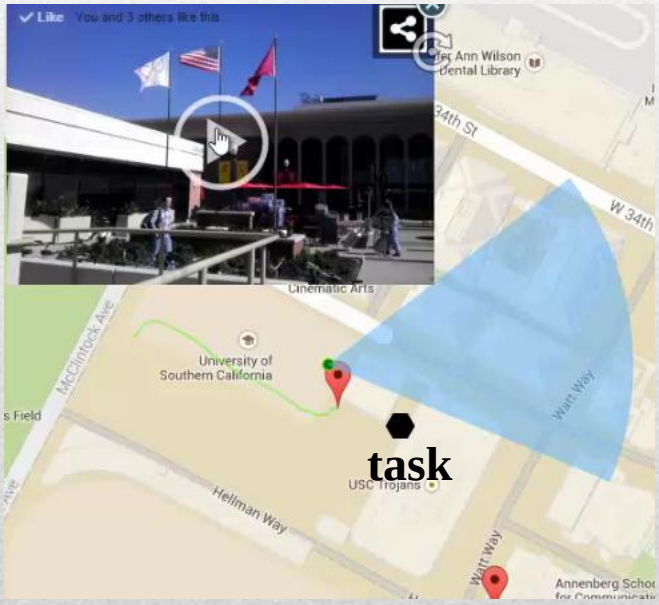
- **The first privacy study in spatial crowdsourcing!**

Trustfulness of Workers

- **Non-spatial metrics**
  - Rating
  - # of transactions
  - Fast response time
  - Quality of work



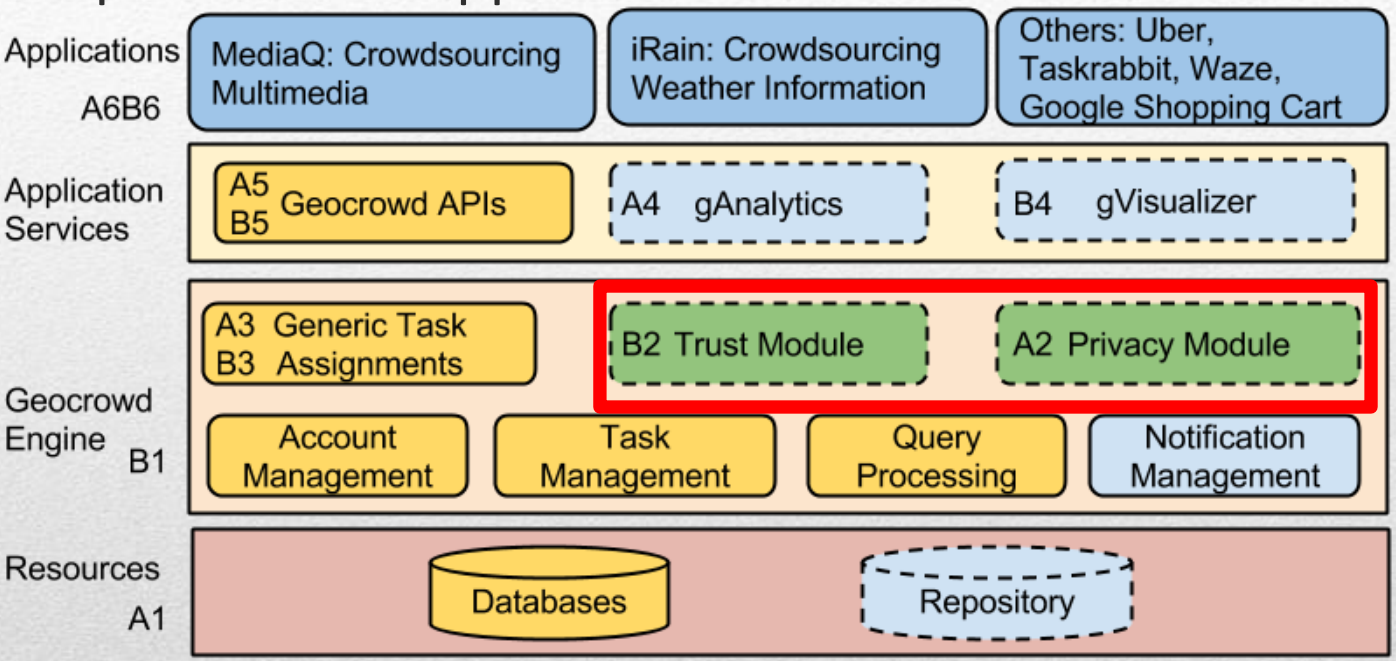
- **Spatial metrics**
  - **Distance traveled**
  - **Spatial coverage**



- **Use reputation-based trust**
  - To maximize the **quality** of the result in task assignment
  - To direct requesters to “trusted” areas in task posting

Proposed Framework & Execution Plan

- Develop a **generic spatial crowdsourcing architecture** to ease the development of SC applications.



Phases	2015				2016				2017	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
A1B1										
A2B2										
A3										
B3										
A4B4										
A5B5										
A6B6										

Evaluation

- Use **real** data workload and generate **synthetic data**
  - e.g. Gowalla, Yelp, Foursquare
- Build **real systems**, e.g., MediaQ, iRain
  - Organize **events** at USC to collect SC data
  - Deploy on **cloud** and monitor workload and system behavior
  - Get feedback via **academic collaboration**
- Publish framework as an **open source project**
  - e.g. github

Team

- **Partnership/Research Accomplishments**
  - SC for collecting media content: **MediaQ** (since 2012)
  - SC for collecting weather information: **iRain** (since 2014)
  - Experience in developing mobile platforms

Prof. Cyrus Shahabi (advisor)
- Pioneered spatial crowdsourcing
- Director of InfoLab; an active research group in spatial crowdsourcing

Hien To (4th year PhD student)
- Research on scalability/privacy of task assignment
- Published papers in prestigious database conferences, e.g., ICDE, VLDB, CIKM
- Completed two summer interns at Teradata in 2012 and 2014

George Constantinou (1st year PhD student)
- His research focuses on trustfulness in spatial crowdsourcing
- Completed a summer intern at Amazon in 2014
- Fulbright fellow

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