The New Casper: Query Processing for Location Services without Compromising Privacy

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Major Privacy Threats in Location-based Services

New technologies can pinpoint your location at any time and place. They promise safety and convenience but threaten privacy and security.  
Cover story, IEEE Spectrum, July 2003

Service-Privacy Trade-off

Example: Where is my nearest bus?

The Location Anonymizer

- The entire system area is divided into grids.
- The Location Anonymizer incrementally keeps track of the number of users residing in each grid.
- Traverse the pyramid structure from the bottom level to the top level, until a cell satisfying the user privacy profile is found.

The Privacy-aware Query Processor

- Step 1: Locate four filters (the NN target object for each vertex)
- Step 2: Find the middpoints (the furthest point on the edge to the two filters)
- Step 3: Extend the query range
- Step 4: Return candidate answers

Theorem 1: Given a cloaked area A for user u located anywhere within A. Casper returns a candidate list that includes the exact answer.

Theorem 2: Given a cloaked area A for a user u and a set of filter target object t, to a Casper issues the minimum possible range query to get the candidate list.

Casper

Location-based Database Server

Privacy-aware Query Processor

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Service vs. Privacy

The Privacy-aware Location-based Database

Privacy-aware Location-based Database

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- Basic Anonymizer
- Adaptive Anonymizer

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Privacy-aware Query Processor

- Exact Answer
- Private Range Query