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**A GEO-INDISTINGUISHABLE LOCATION PERTURBATION MECHANISM FOR LOCATION-BASED SERVICES SUPPORTING FREQUENT QUERIES**

**ABSTRACT:**

As location-based services (LBSs) on smartphones become increasingly popular, such services are causing serious privacy concerns, because many users are unwilling to see their location information leaked to service providers. Recently, in order to protect users' location privacy, researchers have introduced geo-indistinguishability, the first specialized privacy model for LBSs that can provide provable privacy guarantees. Intuitively, geo-indistinguishability means that through perturbation, any two locations within a given distance produce observations with similar distributions, and thus, attackers have no way to learn users' real locations. However, even if geo-indistinguishability is achieved, there remains a significant threat to users' location privacy: the privacy consumption increases with the number of queries for the existing geo-indistinguishable location perturbation mechanism, and therefore, there is a high risk of privacy violation when the number of queries is not small. In this paper, we enhance the privacy protection for LBSs by proposing an improved geo-indistinguishable mechanism. It can reduce the privacy costs to almost 0 when the user's location satisfies a condition. We also present an improvement to further reduce the privacy costs when the above condition is not satisfied. Evaluations upon two public trace data sets show that the proposed mechanisms can dramatically save the privacy budget and thus support much more queries. The results also show that the proposed mechanisms are efficient, and their performance is controllable.