

Motivation

Uber

iNaturalist

yelp

Ride Hailing

Citizen Science

Locality-based Search Engine

40 states settle Google location-tracking charges for \$392M

By DAVE COLLINS and MARCY GORDON November 14, 2022

AccuWeather caught sending user location data, even when location sharing is off

A security researcher has found that the popular weather app sends private location data without the user's explicit permission to a firm designed to monetize user locations. Zack Whittaker Aug. 22, 2017

Fitness tracking app Strava gives away location of secret US army bases

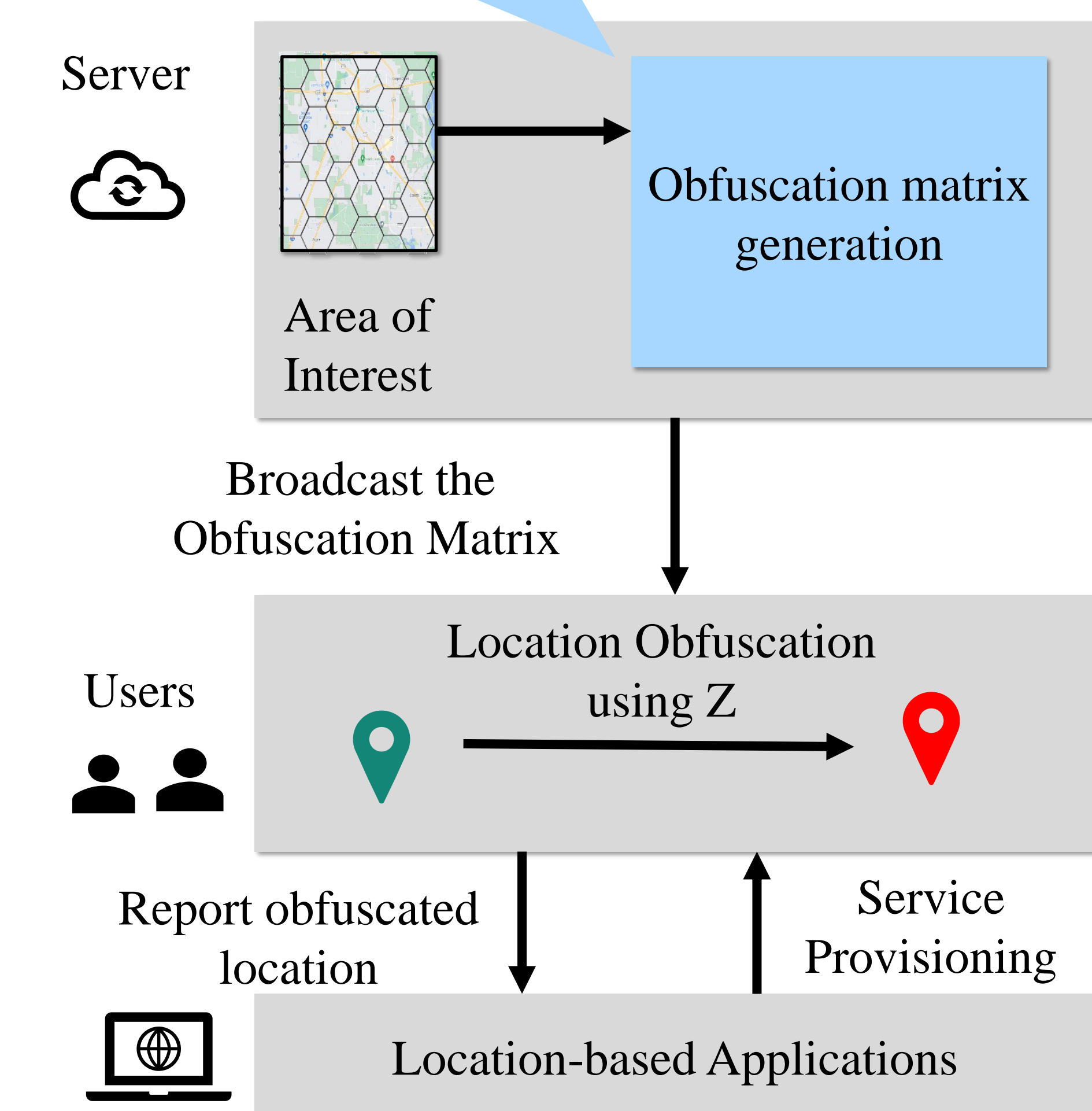
Alex Hern 28 Jan 2018

Data about exercise routes shared online by soldiers can be used to pinpoint overseas facilities

Existing Approaches

Geo-Indistinguishability based Location Obfuscation Andrés, Miguel E., et al (2013)

$$Z = \begin{bmatrix} Z_{1,1} & \dots & Z_{1,K} \\ \vdots & \ddots & \vdots \\ Z_{K,1} & \dots & Z_{K,K} \end{bmatrix}$$



1. Customization not supported
2. Lack of Robustness

Qiu et. al (2020), Shokri et.al. (2012), Wang et.al. (2017)

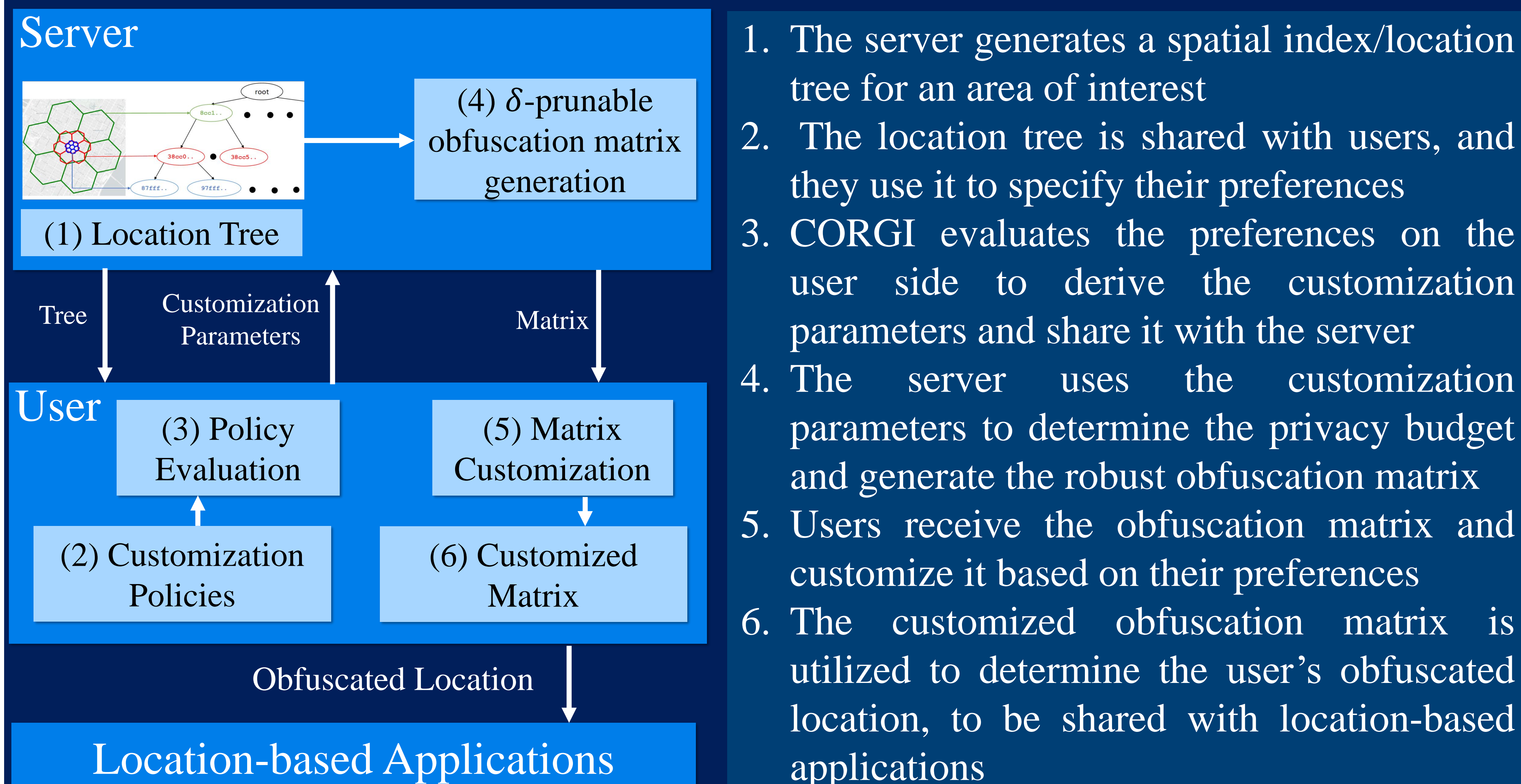
CORGI: An interactive framework for Customizable and Robust Location Obfuscation

Primal Pappachan (Pennsylvania State University); Vishnu Sharma Hunsur Manjunath (Pennsylvania State University); Chenxi Qiu (University of North Texas); Anna Cinzia Squicciarini (Pennsylvania State University); Hailey Onweller (Pennsylvania State University)



1. Allow users to **customize** obfuscation functions
2. Ensure **robustness** of functions after customization
3. Improve efficiency of location obfuscation workflow

CORGI Workflow

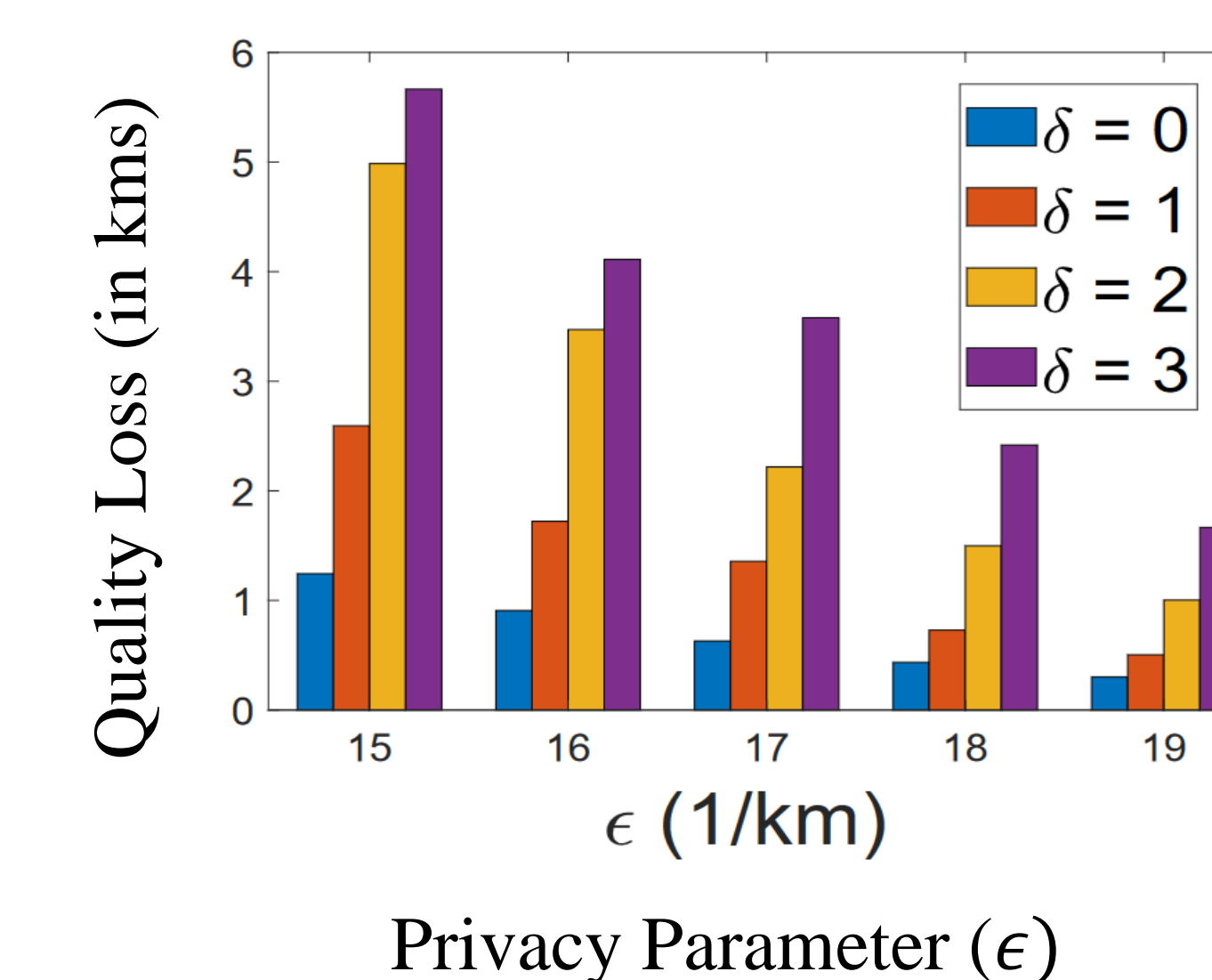


1. The server generates a spatial index/location tree for an area of interest
2. The location tree is shared with users, and they use it to specify their preferences
3. CORGI evaluates the preferences on the user side to derive the customization parameters and share it with the server
4. The server uses the customization parameters to determine the privacy budget and generate the robust obfuscation matrix
5. Users receive the obfuscation matrix and customize it based on their preferences
6. The customized obfuscation matrix is utilized to determine the user's obfuscated location, to be shared with location-based applications

Results

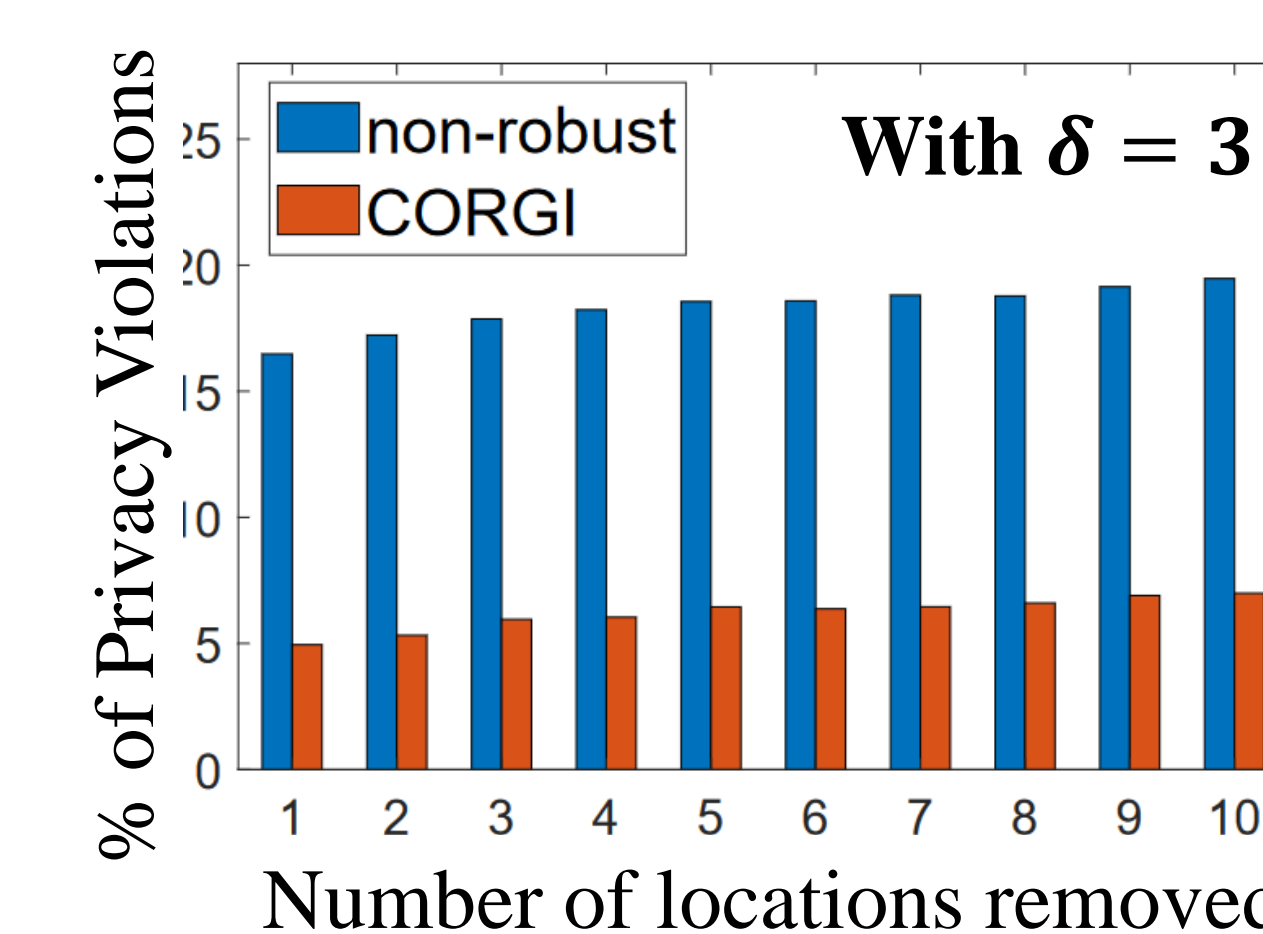
- **Dataset:** Gowalla which contains real-life user check-ins in different locations
- **Location Tree:** generated using H3 library
- **Baseline:** non-robust approaches by prior works

Utility Impact



Quality loss **decreases** as **higher** ϵ implies weaker constraint
Quality loss **increases** as **higher** δ introduces higher privacy budget

Privacy Impact



Number of violations in **baseline** is **~6X** compared to **CORGI**.

Conclusions & Future Work

- User Customization leads to weakening privacy guarantees of location obfuscation
- **CORGI** enables robust customization of obfuscation functions
- In future, support user customization with improved utility and sharing of trajectories

