

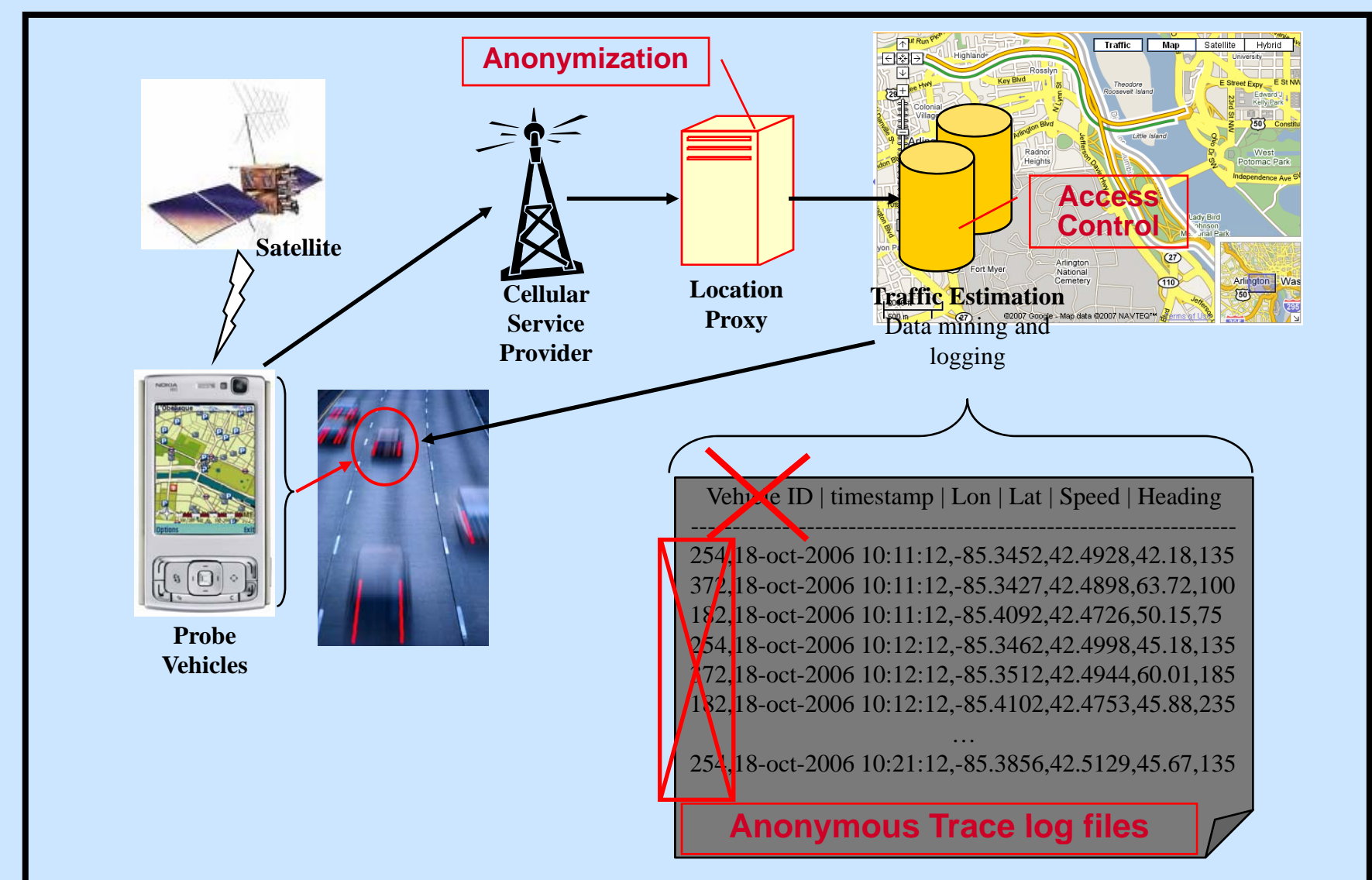
Multi-Layer Anonymity Techniques for Time-Series Location Information in Wireless Systems



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Protecting Location Privacy

Goal: Develop framework, metrics, and algorithms for enhancing location privacy in wireless applications using techniques from target tracking and data mining.



Example: Naïve anonymization in automotive traffic monitoring application

Approach and Impact

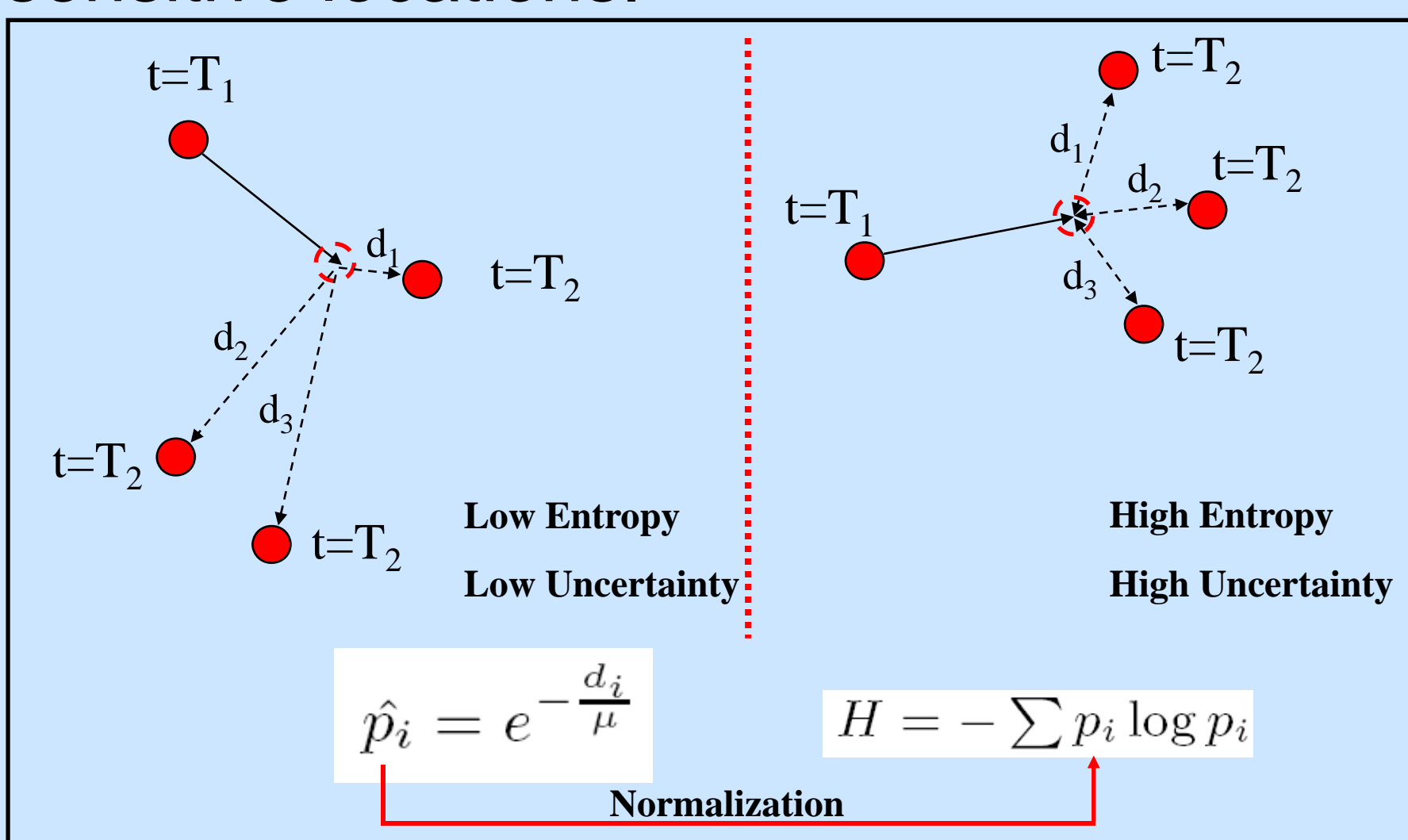
New approach

- Address time-series nature of location traces through tracking uncertainty-aware disclosure control algorithms
- Use target tracking and data mining algorithms to understand privacy risks from real-life GPS traces of 200+ vehicles collected with industry partners

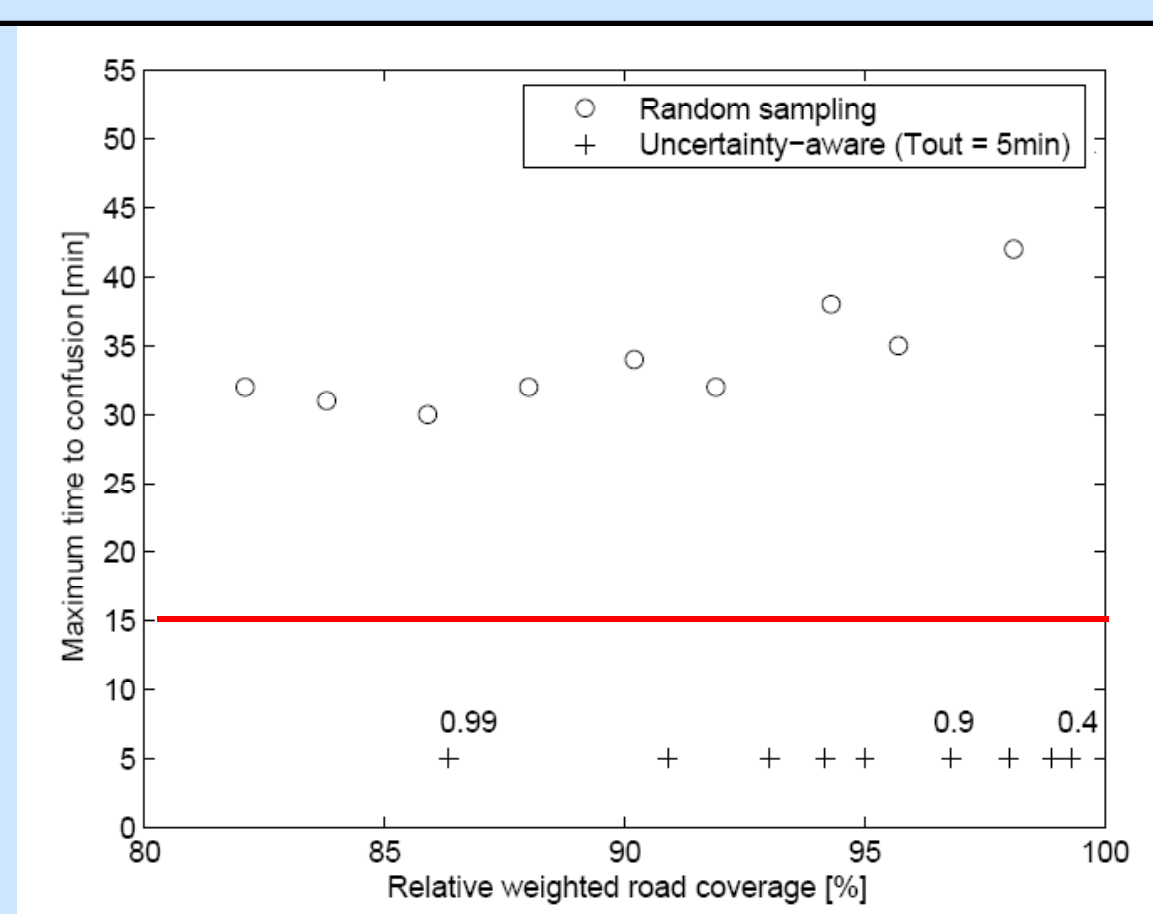
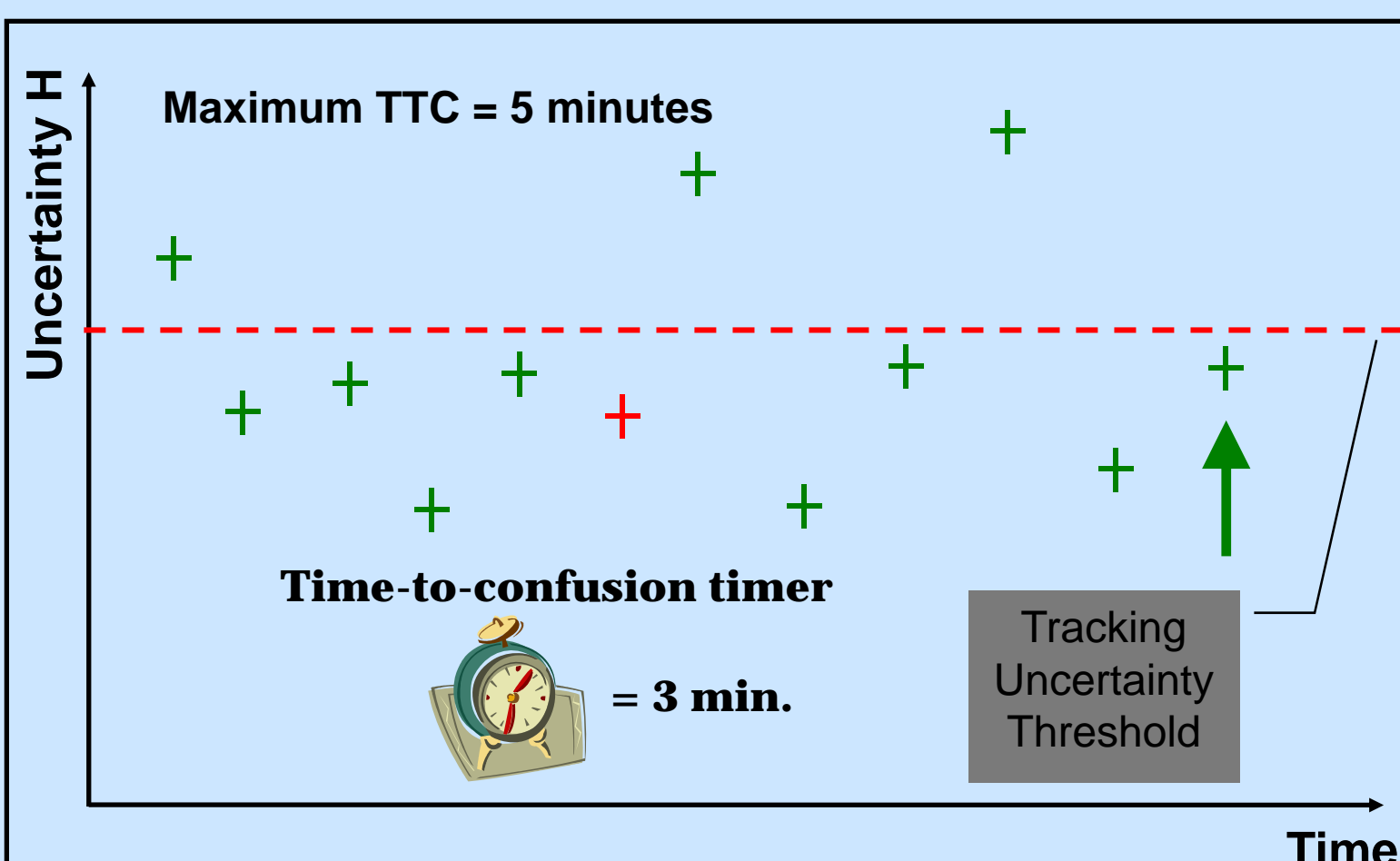
Research Impact

- Develop novel privacy algorithms and metrics for time-series information
- Inform standards (e.g., IETF Geopriv) development

Privacy Risks. We highlight two risk scenarios arising from data mining techniques, home identification and tracking, even if each location sample is reported anonymously. Home identification allows an intruder to identify the locations of the homes from data subject, leading eventually to identification of the subjects. Tracking allows reconstructing longer paths of individual subjects from the anonymous samples, potentially revealing visits to sensitive locations.



Time-to-Confusion Metric. The degree of privacy risk depends on how long an adversary can follow a subject. Our novel privacy metric, a Time-to-confusion (TTC) criterion measures time an adversary can track one subject with high confidence. Formally, it specifies a time duration where tracking uncertainty (see illustration) remains lower than a confusion threshold.



Uncertainty-Aware Path Cloaking. We developed a centralized disclosure control algorithm that selectively reveals GPS samples to limit the maximum time-to-confusion given user preference parameter, a confusion threshold.

Selected Publications:

- Baik Hoh and Marco Gruteser and Hui Xiong and Ansaif Alrabady. Preserving Privacy in GPS Traces via Density-Aware Path Cloaking. ACM Conference on Computer and Communications Security (CCS), 2007
- Enhancing Security and Privacy in Traffic-Monitoring Systems. Baik Hoh, Marco Gruteser, Hui Xiong, Ansaif Alrabady. IEEE Pervasive Computing Magazine (Special Issue on Intelligent Transportation Systems), 5(4), 2006