Persistent Traffic Cookies
Real Time, Distributed Vehicle Travel History Database
The conventional approach to traffic system monitoring and control involves a one-way link via point detection (e.g., Inductive Loop Detectors) ... 

... but Intelligent Transportation System applications such as ATIS, ATMS, and RGS require path-level measurements such as vehicle routes and travel times.

So ... how can such vehicle-centric measurements be obtained in practice, and in real time?

One potential solution: **Persistent Traffic Cookies (PTC)**
What is PTC system?

The PTC system can:
- Uniquely identify each vehicle over time
- Track vehicles over multiple days and trips
- Store travel history data within vehicles
- Process and deliver data to where it’s needed

The PTC idea:
- Vehicles have small wireless devices that can communicate to roadside controllers. A short-range connection is established and a *traffic cookie* (location + timestamp) is written to the on-board database. Continuous tracking throughout the network generates a complete vehicle travel history. The traffic cookies remain in the database, persistent from trip to trip (thus, *Persistent Traffic Cookies*, or PTC).
A PTC Example
PTC System Features

- Authenticated “cookies” stored in vehicles detail movement through the network.
- The PTC database represents a complete travel history for the vehicle.
- The decentralized databases eliminate a huge data storage requirement.
- Vehicles become a cooperative part of system, “hand carrying” their data to local controllers.
- The driver can deactivate and/or clear the PTC database at any time, preserving privacy.
- Travel history can be used to predict behavior.
- Such predictions can be used to produce estimates of actual travel demand.
What is microscopic traffic simulation?
- A computer model that represents a real-world transportation network and individual vehicles at a very detailed level.
- Paramics is such a model enjoying widespread use

Why use microscopic traffic simulation for PTC?
- Real world implementation is not available for the near future. Simulation is a good way for initial testing and evaluation.
- Evaluation requires modeling individual driver behavior.
- Need to obtain the parameters of interest for both on-line and off-line analysis.
- APIs to extend required functionalities.
- Visualization of modeling results
Framework of PTC Simulation

Activity Simulation
CasaSim
Simulation of person's activity pattern according to attributes of person, land use system and transportation system

Microscopic Traffic Simulation Paramics
Simulation of vehicles running in a network

Data Storage
MySQL
Driver's attributes
Network topology
PTC data
Other parameters of interest

Trip Generated
Trip Finished

Generating Persistent Traffic Cookies

Offline analysis

Online analysis

At each simulation time step,
for each vehicle,
if vehicle connected with a PTC station
    Compute the distance between this vehicle and the connected station
    if distance > communication radius
        Write a leveling cookie to a data structure associated with the vehicle
else
    For each PTC station
        Compute the distance between this vehicle and the station
        if distance < communication radius
            Write an arriving cookie to a data structure associated with the vehicle
Micro-simulation of PTC

PTC simulation at a typical signalized intersection in Paramics

Traffic Signals

PTC Station

PTC Vehicles

Communication Radius

PTC vehicle turns back to original color if the connection is lost.

PTC vehicle turns to YELLOW if it establishes connection with a PTC station.

PTC strings stored within this vehicle are reported here.
Sample Simulated PTC Data

- ...
  OUT:ps11|
  OUT:ps33|
  OUT:ps33|
- ...


Technical feasibility is being evaluated in the laboratory and in defined field tests.

Institutional feasibility involves the acceptance of the technology by the population in general and by the traffic control community.

As a first step in assessing potential acceptance, a survey has been designed and a pre-test completed.

The survey queries for information on:
- respondents and their work commutes
- respondent attitudes towards privacy issues
- Alternate ways to pay for this system

Pre-test: 35 UCI Commuters (faculty, staff, students) randomly surveyed at parking garages at end of day
PTC User Survey

Your Zip code: ____________

Are You: faculty □ Student □ Staff □

1. Do you use: (Check all that apply)
   GPS □  Cellphone □  PDA □
   Car Navigation System □

2. How long is your avg. morning commute (to UCI)
   ___________ time (minutes)

3. How well do you rate your commute?
   Bad □  Poor □  Ok □  Good □  Great □

4. What do you think will make your commute better?
   Rate order of importance 1 to 5, 5 being most important
   and 1 being less important.
   1  2  3  4  5  Less waiting at traffic signals
   1  2  3  4  5  Less congestion on the freeway
   1  2  3  4  5  Better information on traffic conditions
   1  2  3  4  5  Better clearing of accidents
   1  2  3  4  5  Easier availability of parking at UCI

5. Suppose you had a 30 minute commute. Which of the following would you choose. Choose only one:
   Benefit  Cost
   □ Save an average of 10 minutes every day
   Provide detailed travel information about your car
   to an agency (Ex.Caltrans)
   □ Save an average of 5 minutes every day
   Provide detailed travel information about your car
   a private company.
   □ Save an average of 2 minutes every day
   Have strong privacy control. (You decide when
to release your travel data)
   □ Do not use the system
   □ Save no time
   Retain complete privacy

6. What payment method would you prefer:
   One Time Fee($450-$600) □  Monthly Fee($10) □
   Per Use Fee: □
PTC User Survey: Pre-test Results

- Do not use the system: Retain complete privacy
- Save no time: Have strong privacy control (you decide when to release data)
- Save an average of 2 minutes every day: Provide detailed travel information about your car to a private company
- Save an average of 5 minutes every day: Provide detailed travel information about your car to an public agency (Ex. Caltrans)
- Save an average of 10 minutes every day:
PTC User Survey: Pre-test Results

- One Time Fee ($450-600)
- Monthly Fee ($10)
- Per Use Fee

Question 6 pct

Freq

0.0 0.1 0.2 0.3 0.4

1

2

3
The UCI ITE Student Chapter:

- Chapter Faculty Advisors:
  - Professor R Jayakrishnan
  - Professor MG McNally

- ITS Researchers:
  - Dr. James Marca
  - Dr. Craig Rindt

- UCI ITE Chapter Offices:
  - J. Paul Townley, President
  - Thach Cao, Vice President
Thank you