Getting There from Here: Traffic Modeling, Data Streams, and Prediction for Connected Vehicle Systems Planning and Operations
The Promise..
Conventional Paradigm:
Collect the minimum data on a “Typical Day” at a Single Location

Now
Progress: HR Data – Traffic Signals

HR Data Application: Intersection Performance

15 min V/C and LOS

Shift green time
Data, Data, Data... CAVs

V2V: reduction in start up lost time & saturation headway

V2I: Each Vehicle a sensor

MultiModal Intelligent Traffic Signal System (MMITSS)

L Head, Presentation, TRB Signal Systems Committee, Tucson, AZ, 2016
CAVs: ECO -Driving

Messages
“Here I am”
Signal Phase & Timing (SPaT)

Speed Advisory
source: UC PATH & BMW)

Field Test
14% Reduction in Fuel Use
Challenges

- **Data**
  *Penetration Rate (will change over time)*
  *Communication Protocols*
  *Operational Characteristics*
  *Regulations*

- **Agencies Operational Analyses** ("Highway Capacity Manual Procedures")
  *Use of “adjustment factors”*
  *Example: Critical Intersection control strategy improves intersection capacity by 7%*

**Source of factors**
*Field data (not yet available)*
*Simulation (assumptions)*
Impact of Penetration Rates: NGSIM Data

Perfect information, $p = 100\%$

$p = 50\%$

$p = 25\%$

$p = 10\%$
CAVs Saturation Headway
CAVs Freeways

Background: AHS Implementation

- Dedicated AHS lanes
- Automated Check-in
- Automated Check-out
- Lateral and Longitudinal Controls
- Automated merging/diverging
- Malfunction Management & Analysis

AHS Demo: San Diego 1997
Models: Capacity of AHS Lane

Capacity = \( C = \frac{v \cdot n}{[ns + a(n - 1) + d]} \) veh / lane / hour

Assume \( v = 72 \text{ k/h}, s = 5\text{m}. \) Then

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<th>n</th>
<th>a</th>
<th>d</th>
<th>C</th>
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Notes

n=20 yields nearly 4 times today’s capacity

capacity proportional to speed
Model: CACC Lane Capacity

Cooperative Adaptive Crouse Control (CACC)
Challenges

- **Data**
  
  Current *TMC systems are not equipped to handle CAV data*
  
  *No standards/procedures for collecting, processing integrating CAV data into existing operations*

- **Models**
  - Simplified assumptions on car-following-lane changing
  - Interactions with manually driven vehicles
  - Calibration to real trajectories – not CAVs
  - Operational and communication protocols

- **Agencies on Operational & Planning Analyses**
  
  *Use of “adjustment factors”*
  
  *What will be the capacity of freeway lane?*
  
  *What link capacity to use in 2030 transportation plans?*
  
  *Pool Fund Study-Oregon DOT*
Implementation Challenges
Background: Initial Deployment Plans

Planned US VII Deployment’06