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Arterial Performance Measures in a Connected Vehicle Environment

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Connected Vehicles

- Significant movement towards wireless communication between vehicles and infrastructure

IntelliDrive℠
Safer. Smarter. Greener.

Connected Vehicle Technology Challenge

Connected Vehicles

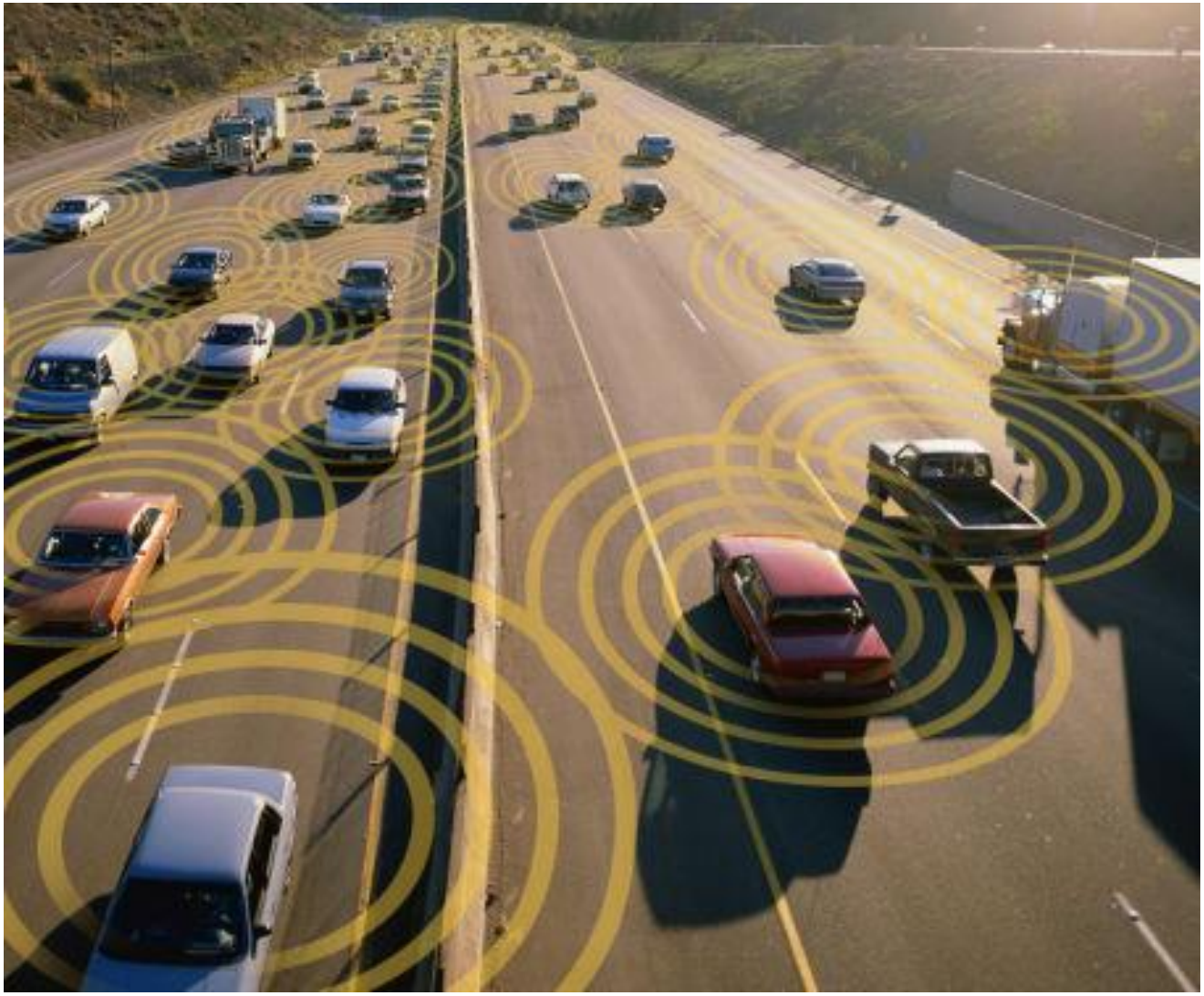
- Communication among vehicles, and between vehicles and roadside infrastructure
- Many ways to communicate
  - WiMAX
  - Wi-Fi
  - Cellular
  - Blue Tooth
  - 3G/4G
- This project focused on DSRC

New Data

- Not just aggregated speed and occupancy
- Can connect to vehicles on-board electronics and measure:
  - Applied brake pressure
  - Windshield wiper status
  - Headlights
  - Steering wheel angle and rate of change
  - Much more!

Point Detection

Wide Area Detection



Project Objective

- These new data allow:
  - Better collection of existing metrics
  - New metrics
  - Contextual information to improve these metrics
- This project's goal is to identify these metrics, and their compatibility with existing standards

Standards

- Society of Automotive Engineers (SAE) J2735 DSRC Message Set Dictionary
  - Best developed connected vehicle standard
  - Updated November 2009
- Most metrics require only the basic safety message (BSM)
  - Sent 10x per second to avoid collisions

Improved Measurement of Existing Metrics

- Vehicle delay
- Headway
- Speed
- Turning movements
- Queue length
- Travel time

New Metrics

- Person delay
  - Vehicle delay often used as the objective function for signal timing. Person delay more fair to carpoolers.
  - DSRC standard allows transmission of a bus's number of passengers. Can deliver more sophisticated transit priority.

New Metrics

- Sudden decelerations
  - May indicate a crash or near-miss
  - Can identify potential unsafe roadways
  - Potentially more information than accidents which are rare and sometimes unreported
  - Uses applied brake pressure, deceleration rate, and anti-lock brake activation

New Metrics

- Change in lateral acceleration
  - Areas with high rates of swerving may also indicate unsafe conditions
  - Can be measured using:
    - Lateral acceleration
    - Steering wheel angle
    - Steering wheel angle rate of change

New Metrics

- Aggregate regulation compliance
  - By anonymizing driver data, can determine areas of unsafe acts and focus enforcement
  - Illegal u-turns, speeding, right turn on red, high speed turns, etc.

Environment and Contextual Information

- These metrics provide information that can improve the accuracy of the other metrics
- Study how vehicles behave in different scenarios can:
  - Improve accuracy of models
  - Improve operations and safety

Environment and Contextual Information

- Roadway weather and light
  - By understanding roadway surface and light conditions, can better understand a vehicle's behavior
  - Example: how do driver's change behavior in heavy rain?
  - Uses vehicles' moisture, sunlight, and temperature sensors

Environment and Contextual Information

- Driver behavior
  - Most understand of driver behavior is based on aggregated data from specific studies
    - Gap acceptance
    - Allowable headway
    - Lane change behavior
    - Free flow speed
  - Information can be collected on a much larger scale, and can be localized by region, type of roadway, and time of day

In Summary

- Approaching a shift in traffic data collection
- Much more data, new types of data, different quality data
- Requires a new way of approaching performance measurement and traffic operations generally

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For More Information

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