



***Volunteer Network of
Professionals Working Together to
Support, Promote, and Improve
Best Practices in the Application
of Traffic Simulation and
Capacity Analysis***

Meeting Agenda

2



Welcome and SimCap Updates

Traffic Modeling and Big Data: Scaling, Synergy, and Success

Connected and Automated Vehicles: Role of Computer and Human-in-the-Loop Simulation in Advancing the Technology

DOTD's DSRC Pilot for Connected Vehicles

ITE SimCap Committee

- Held committee meeting (Nov. 16)
 - Materials posted to [SimCap e-Community](#)
- [ITE website](#) is UP!
 - Continually collecting feedback
- Submitted session for 2021 ITE Annual Meeting
 - In review (competitive)



ITE SimCap Committee

- Upcoming meeting (week of ITE Council Meetings)
 - Jan. 12, 2:30–2:00p CST
- Potential initiative
 - Defining practitioner “core competencies”
 - Send resources/input to cmelson1@lsu.edu



TRB Standing Committee on Traffic Simulation

- Hosted workshop (Nov. 16–18)
 - “Workshop on Traffic Simulation and Connected and Automated Vehicle Modeling”



2021 TRB Annual Meeting

- Traffic Simulation Committee
 - Jan. 5, 9:00–10:30a CST
- Simulation Subcommittee (SimSub)
 - Jan. 5, 11:00–12:30p CST
- Research Subcommittee Meeting
 - Jan. 5, 3:00–4:30p CST
- Traffic Simulation 2021
 - Jan. 27, 1:30–3:00p CST & Jan. 28, 10:30–12:00p CST
- Traffic Simulation Research and Provision of Guidance
 - Jan. 28, 12:00–1:30p CST





STREETLIGHT
DATA

Jim Hubbell

Streetlight Data

Traffic Modeling and Big Data: Scaling, Synergy, and Success

Simulation and Capacity Analysis User Group: Louisiana

December 8, 2020

Jim Hubbell, AICP

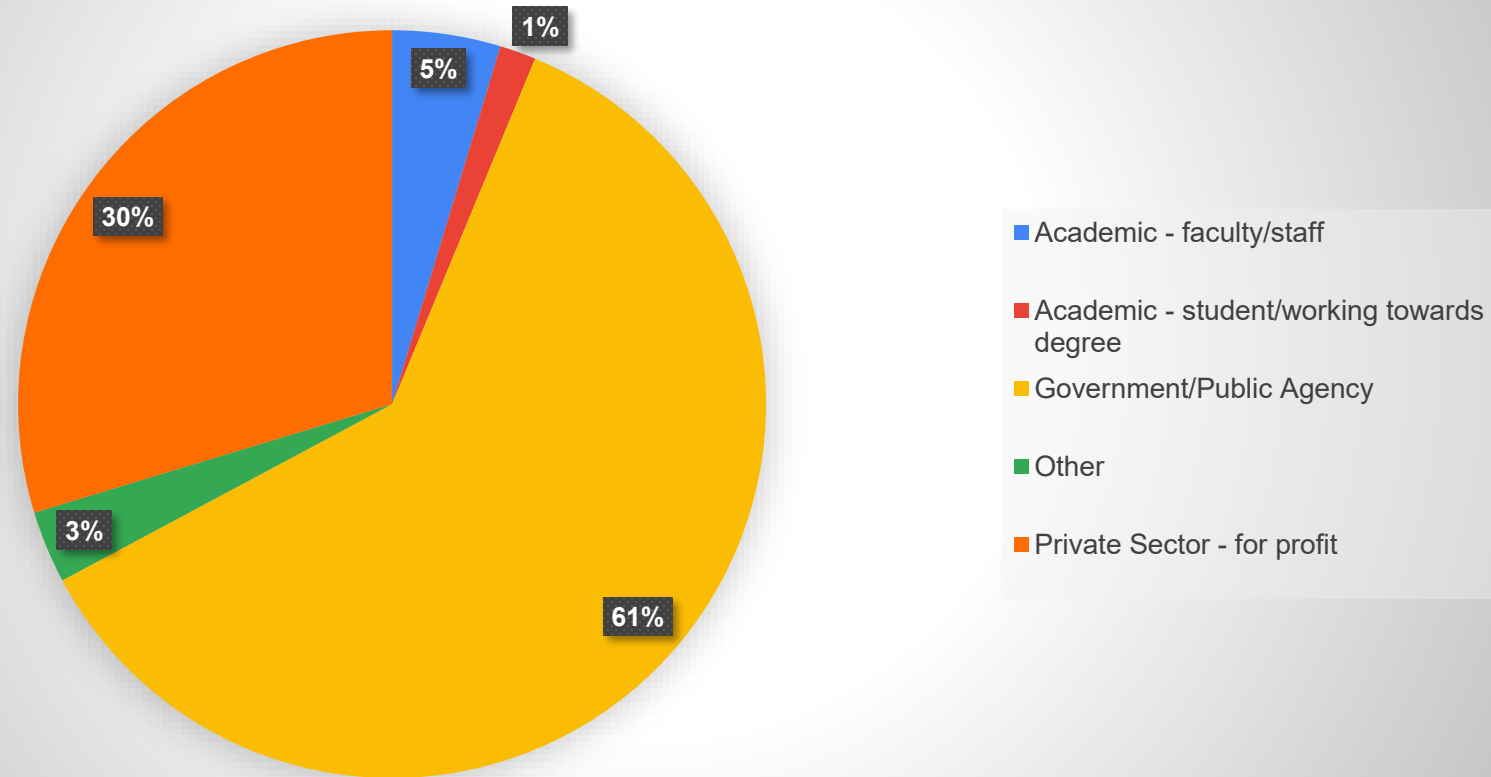
Senior Transportation Solution Engineer

Jim.Hubbell@streetlightdata.com

The Intersection of Survey and Passive Data

Zephyr Foundation Webinar 9/14/20

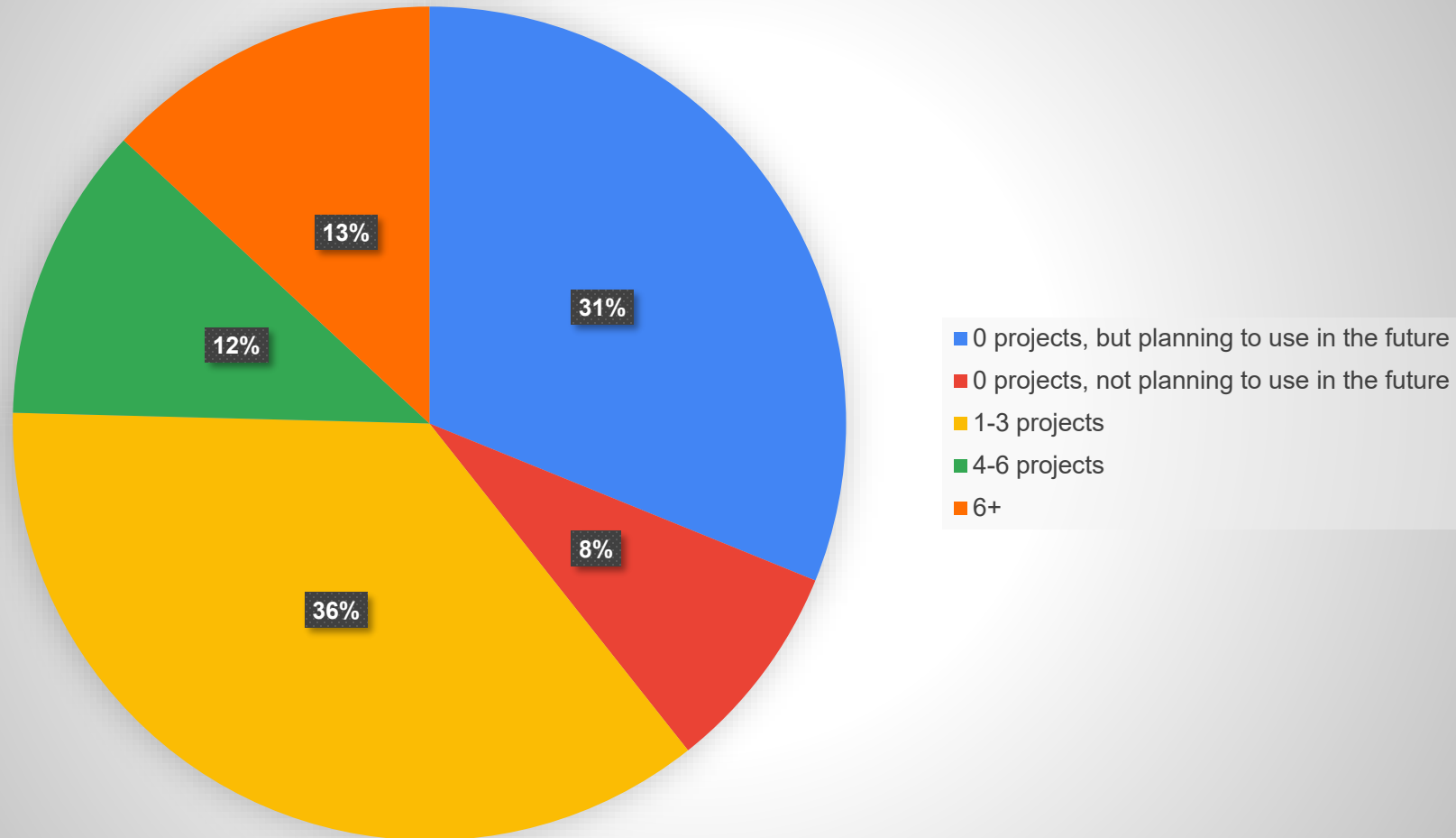
Which of the following best describes your current profession?



The Intersection of Survey and Passive Data

Zephyr Foundation Webinar 9/14/20

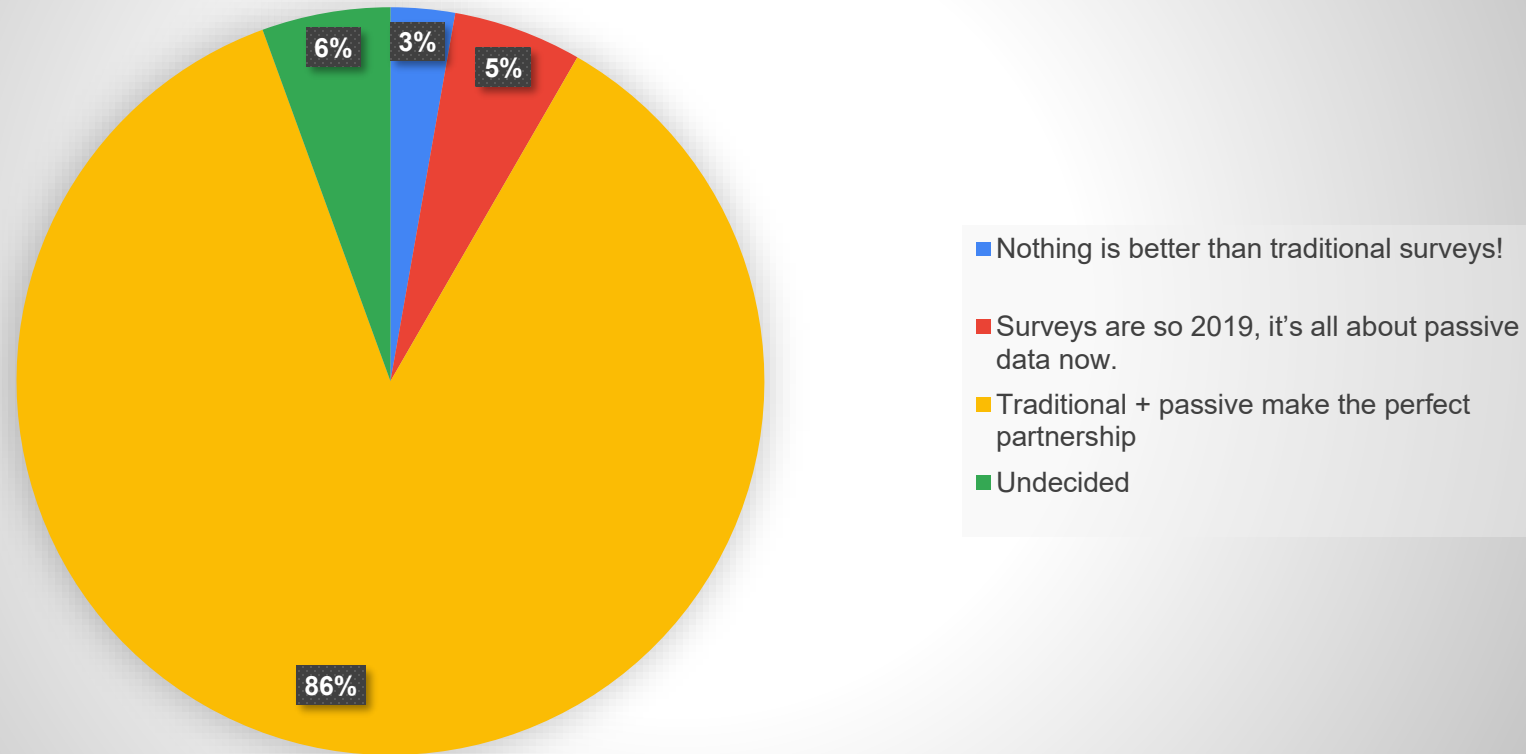
Have you previously used passive data to support a project?



The Intersection of Survey and Passive Data

Zephyr Foundation Webinar 9/14/20

What do you think is the best practice currently for travel surveys?



Agenda

1. Introduction
2. StreetLight Data Overview
3. Big Data for Modeling
4. What You Should Know
5. Discussion



Traditional Data

Can't we all just get along?

Most commonly used traditional transportation data sources:



Household & Intercept Surveys



Aerial Photos & Videos



Bluetooth & Other Sensors



Assumption-Based Modeled Data

Pros

- ✓ Familiar
- ✓ Typically available
- ✓ Historically used
- ✓ Developed processes
- ✓ Purchasing models in place
- ✓ Understood limitations

Cons

- ✗ Expensive
- ✗ Time-Consuming
- ✗ Conducted Rarely
- ✗ Small Sample Sizes
- ✗ Incomplete Information
- ✗ Cumbersome Data Integration
- ✗ Often not current

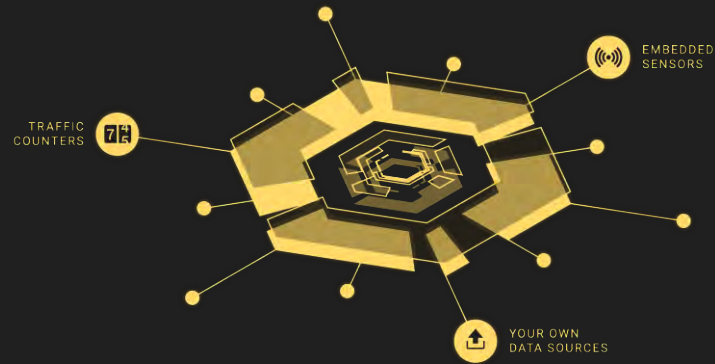


Big Data/Passive Data

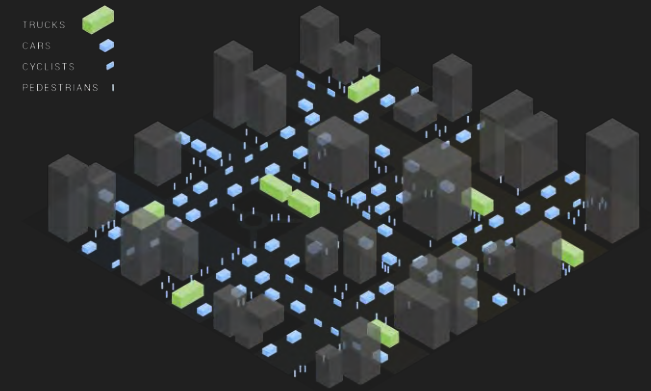
Can't we all just get along?



Collect



Process



Validate



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How we get there:

Big Data and proprietary Route Science®



MOBILE DEVICE DATA
110 million usable devices

Example, San Bernardino, CA
Oct 8, 2017 24-hr snapshot

CONTEXT

Parcel Data
Digital Road Network Data
U.S. Census

- Every month, we process over 100 billion anonymized location records from **smart phones** and **GPS navigation devices** in cars and trucks.
- **Route Science®** transforms them into **contextualized**, normalized and aggregated travel patterns.



At your fingertips: Analytics for every road, bike lane and Census Block

MODES:

Trucks
Cars*
Cyclists
Pedestrians



* Ride hailing and delivery mode also available

FUNDAMENTAL ANALYTICS:

Origin Destination

Routing

Select Link

AADT, MADT, hourly traffic

TRIP ATTRIBUTES:

Trip speed, duration, length

Travel time

Trip circuitry

TRAVELER ATTRIBUTES:

Inferred trip purpose

Demographics

Coming in 2021:
Bus and Rail
modes



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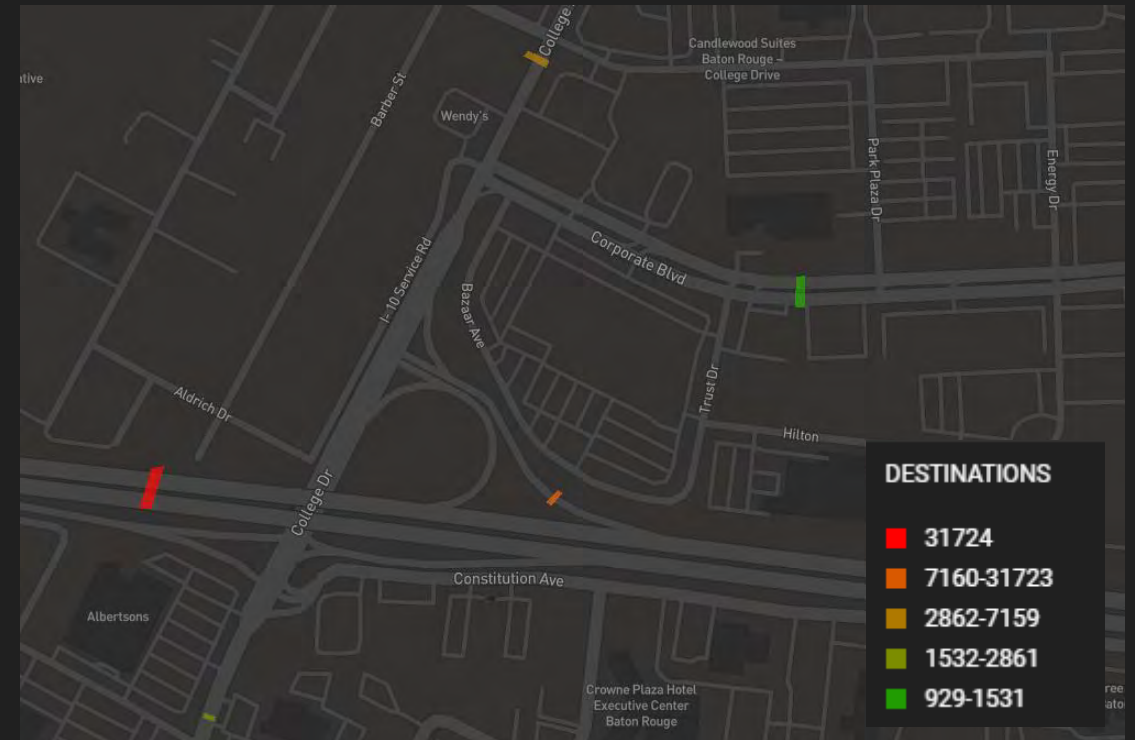


Origin-Destination

Zone to zone



Gate to gate



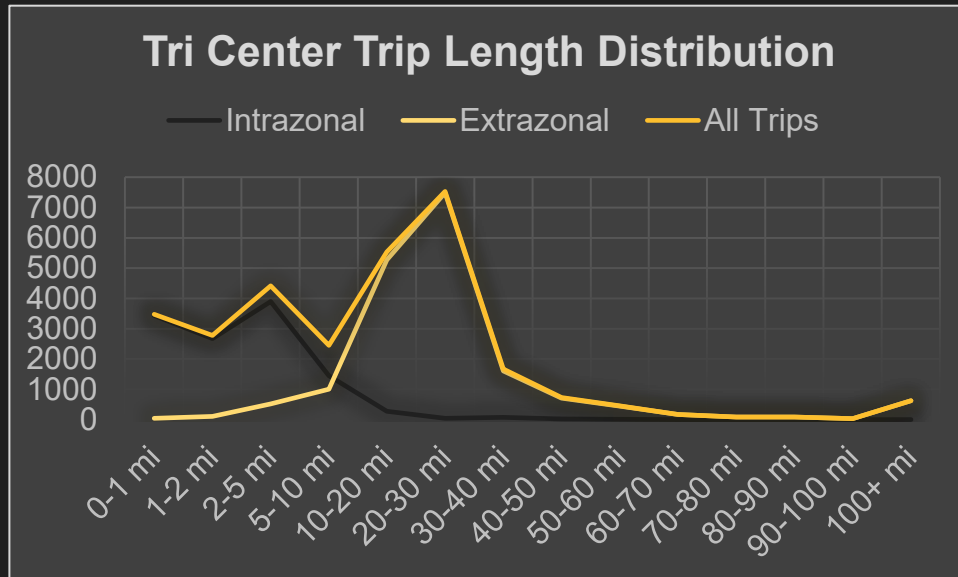
So much more!

1. Trip Attributes
2. Traveler Attributes
3. Routing Details
4. Multimodal Travel



Trip Attributes

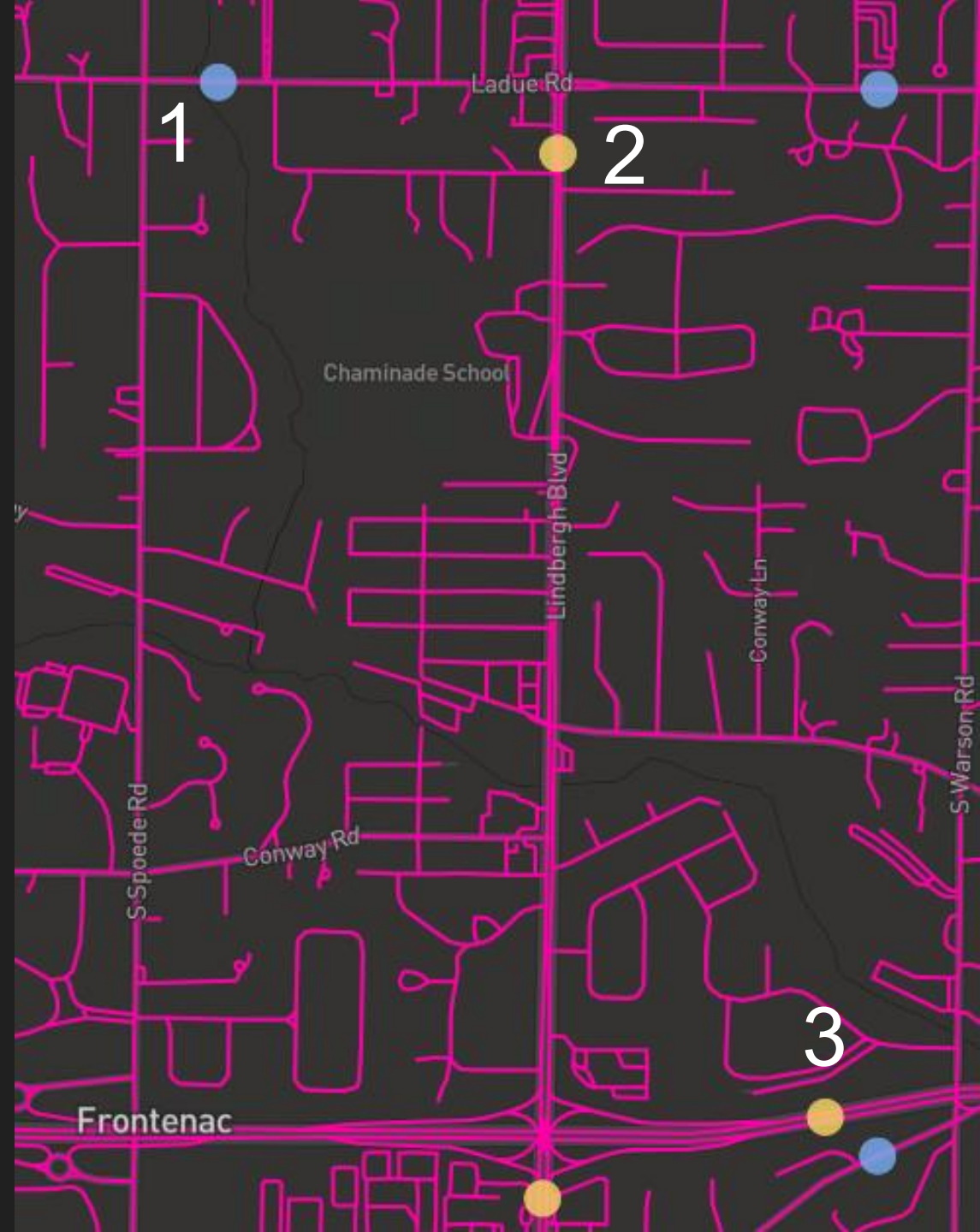
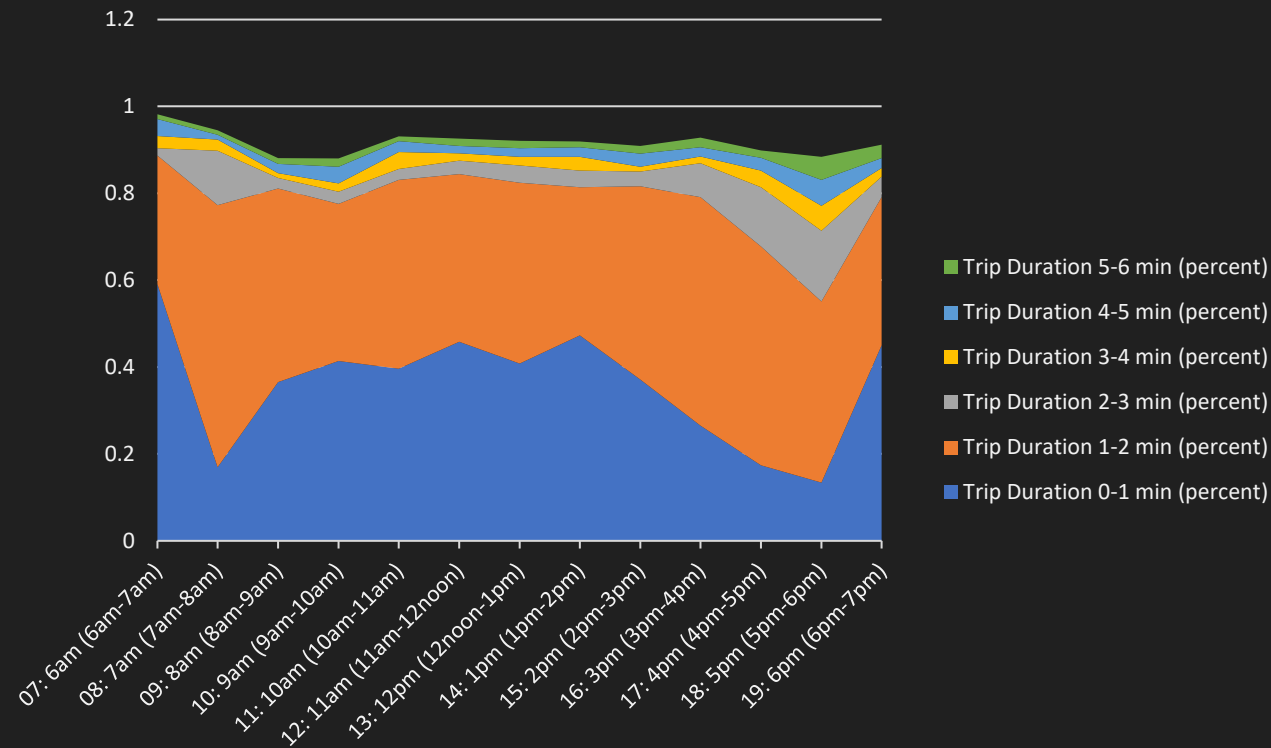
Treasure trove of trip lengths



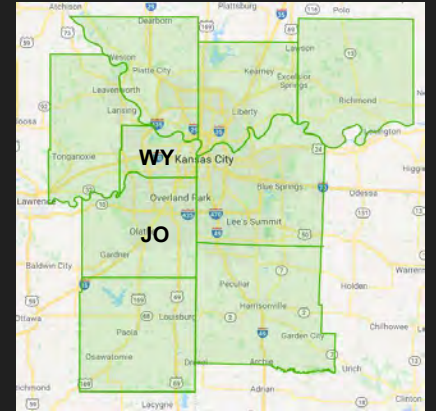
Trip Attributes

Speed and Travel Time

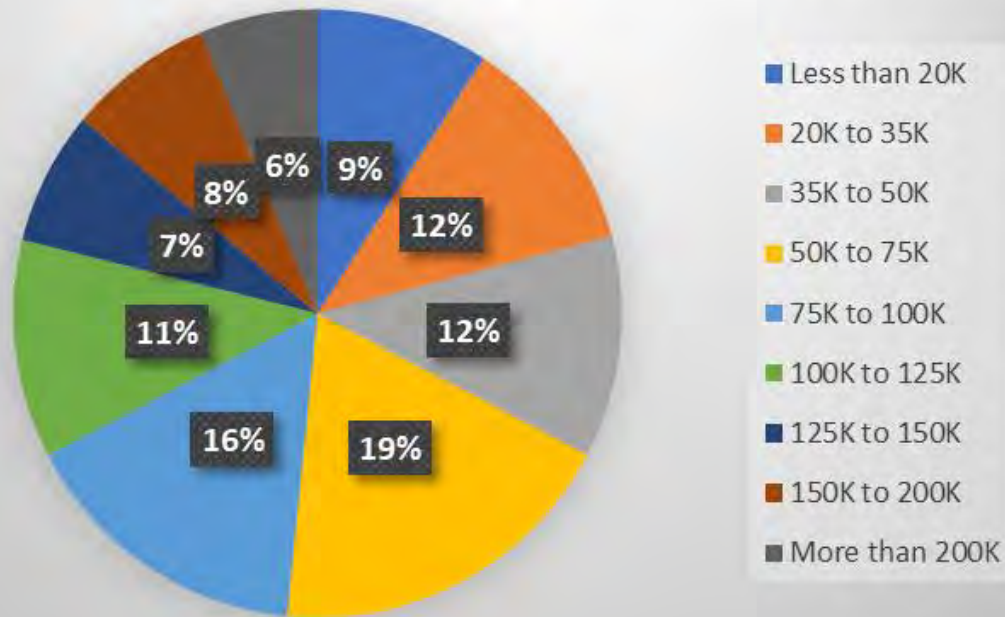
W Ladue Rd to Lindbergh Blvd SB



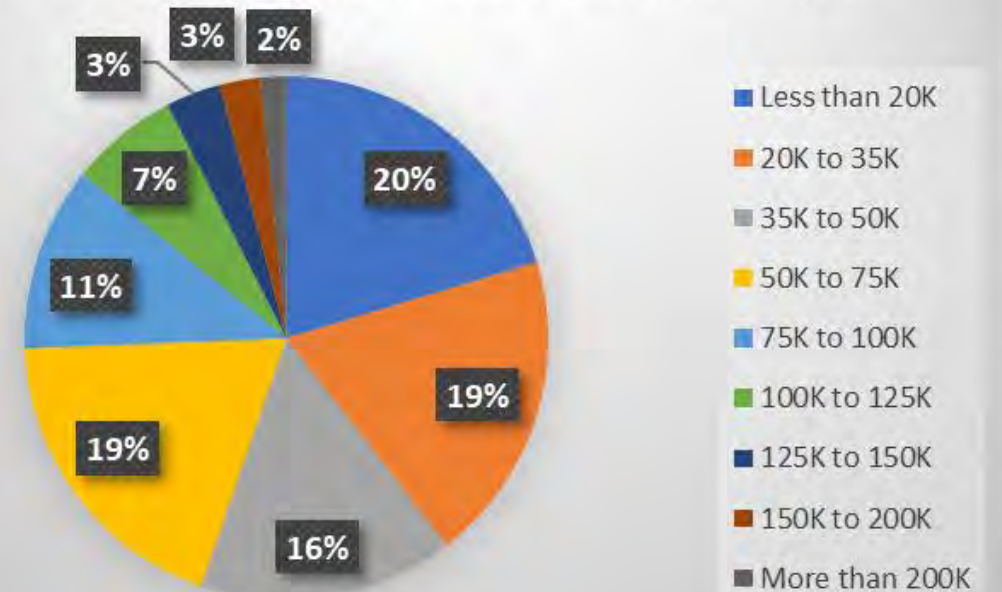
Traveler Attributes



Summer 2020 Bicyclist Income - Johnson County, KS



Summer 2020 Bicyclist Income - Wyandotte County, KS



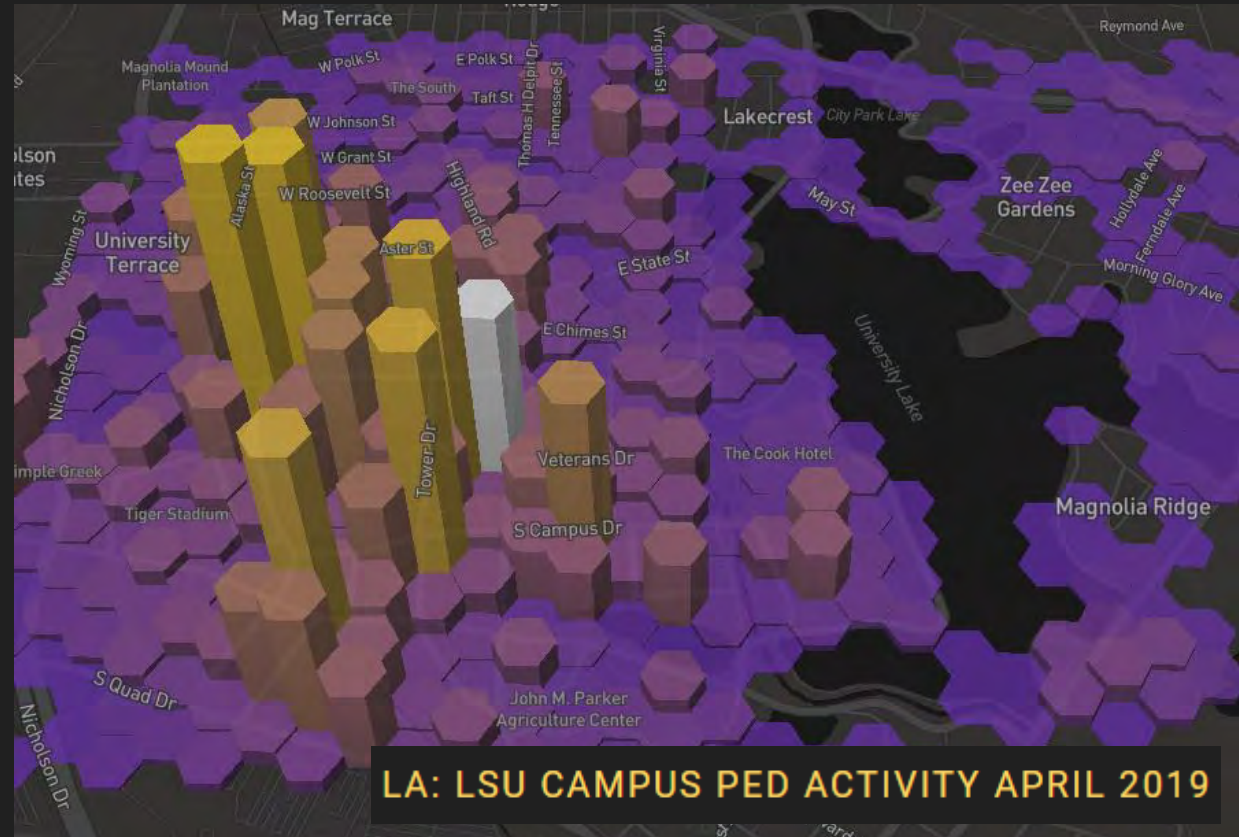
Routing Details



- Path building algorithms
- Trip assignment assumptions
- Network attributes



Multimodal Travel



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Vetting Big Data Metrics Providers

A FRAMEWORK FOR QUESTIONS TO ASK AND BEST PRACTICES TO LOOK FOR

1

Data Sets and Sources

- Where does the data come from?
- How big is the sample size, and from how many providers?
- How frequently are the data sources evaluated and updated?

2

Processing Methods

- What algorithm and machine learning techniques are used?
- How granular are the metrics?
- What transportation modes are included?

3

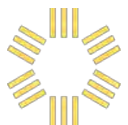
Privacy Protections

- How is the data collected, processed, and shared?
- How does the process protect privacy of individuals?
- Where are privacy practices built into the process?

4

Validation and Uses

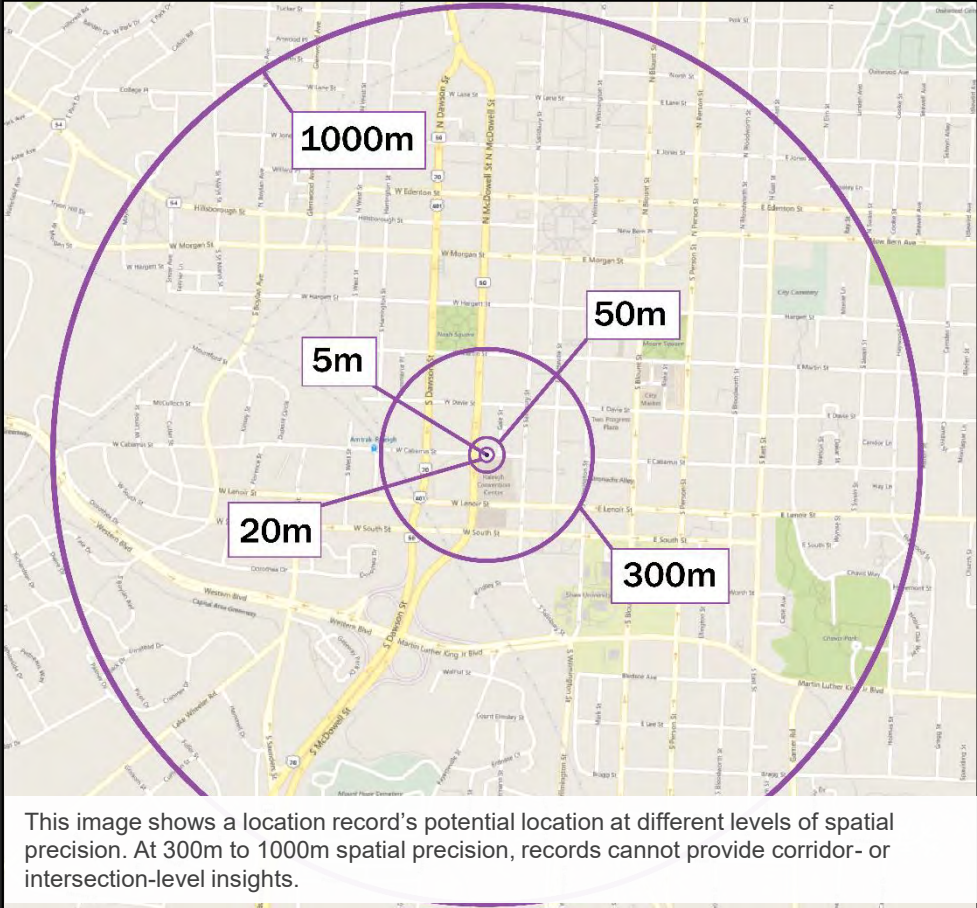
- How are the metrics validated?
- How have the metrics been used in real-world applications?
- How do customers access the metrics?



Our Big Data resources deliver a large sample – plus spatial and temporal precision



Key Characteristics of Our Locational Big Data	
Multiple Types of Data	<ul style="list-style-type: none">Location-Based Services recordsNavigation-GPS records
Sample Size	<ul style="list-style-type: none">Covers 1.5 billion trips in a typical monthUnbiased sample backed up with automated normalization
Spatial Precision and Coverage	<ul style="list-style-type: none">As precise as 5-25 meters, average better than 18 meters4-carrier coverage – no rural gaps
Temporal Precision	<ul style="list-style-type: none">One-hour intervalsWeekends vs. weekdays
Archival Data	<ul style="list-style-type: none">Monthly data periods from 2014 through “month before last”
Privacy Protection	<ul style="list-style-type: none">All data is de-identified by our suppliersNo personally identifying informationMetrics are aggregated into groups



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**Senior
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STREETLIGHT DATA



Osama Osman
University of Tennessee-Chattanooga

Connected/Automated Vehicle Technology: *Role of Computer and Human-in-the-loop Simulation in Advancing the Technology*

Osama A. Osman, Ph.D.

Assistant Professor

Department of Civil and Chemical

Sustainable Mobility Group Leader

Center for Urban Informatics and Progress

University of Tennessee at Chattanooga



Connected Vehicle Technology



OBU



V₂X

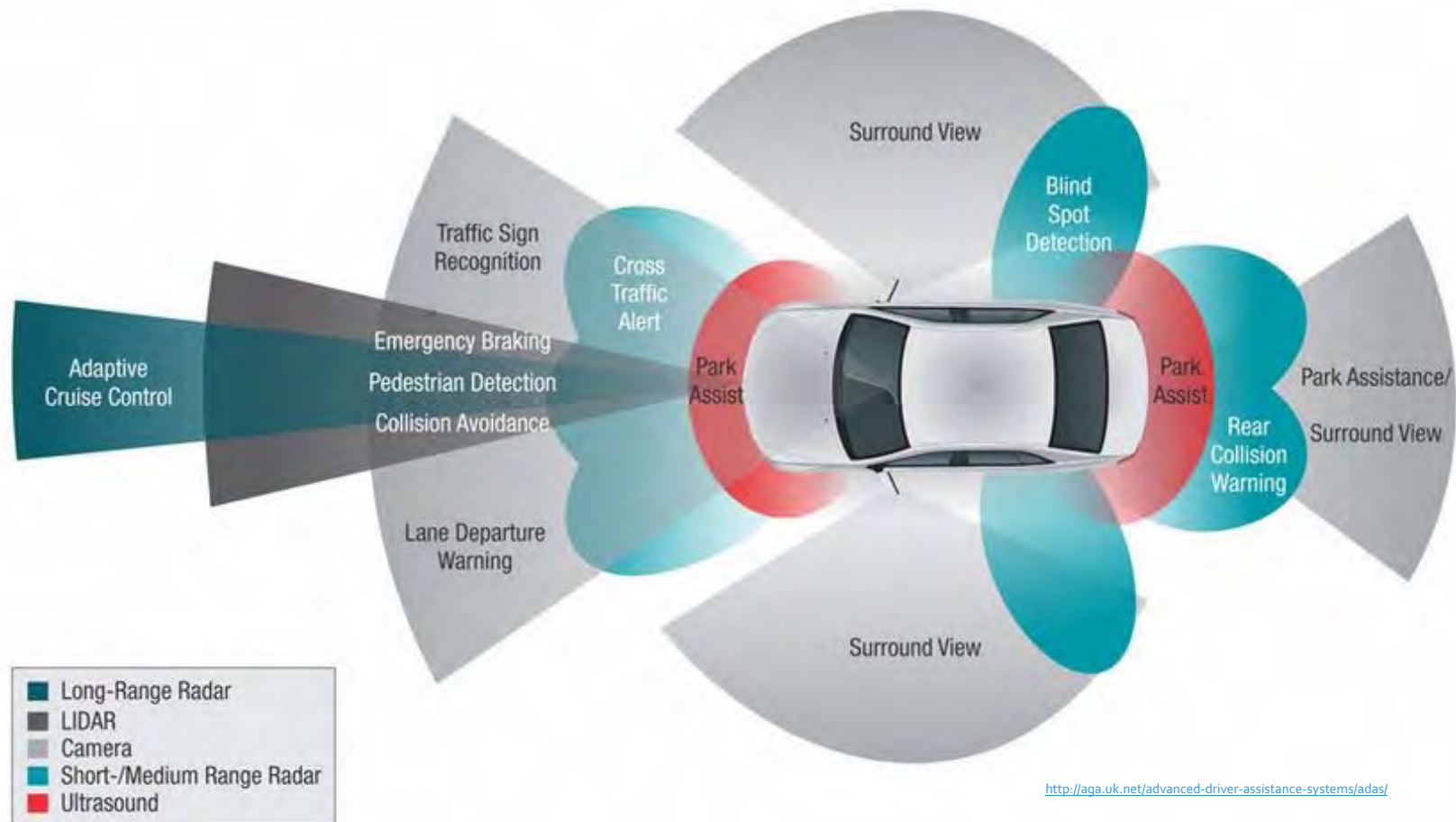


RSU



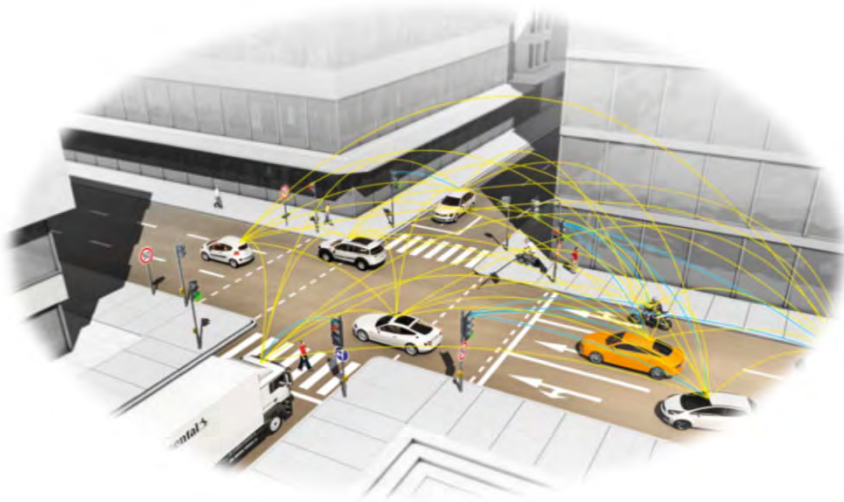
C-V₂X

Autonomous Vehicle Technology



<http://aga.uk.net/advanced-driver-assistance-systems/adas/>

Connected/Automated Vehicle Framework



<http://sites.ieee.org/connected-vehicles/2015/09/10/continental-presents-left-turn-assist-based-v2x-frankfurt-motor-show/>

Questions



- **What impacts do these technologies have on safety, mobility, and energy efficiency?**
- **How are people interacting with these technologies?**
- **Do we have ideal scenarios all the time?**

Presentation Structure



Computer
Simulation

- Eco-Driving
- Cooperative Driving Automation

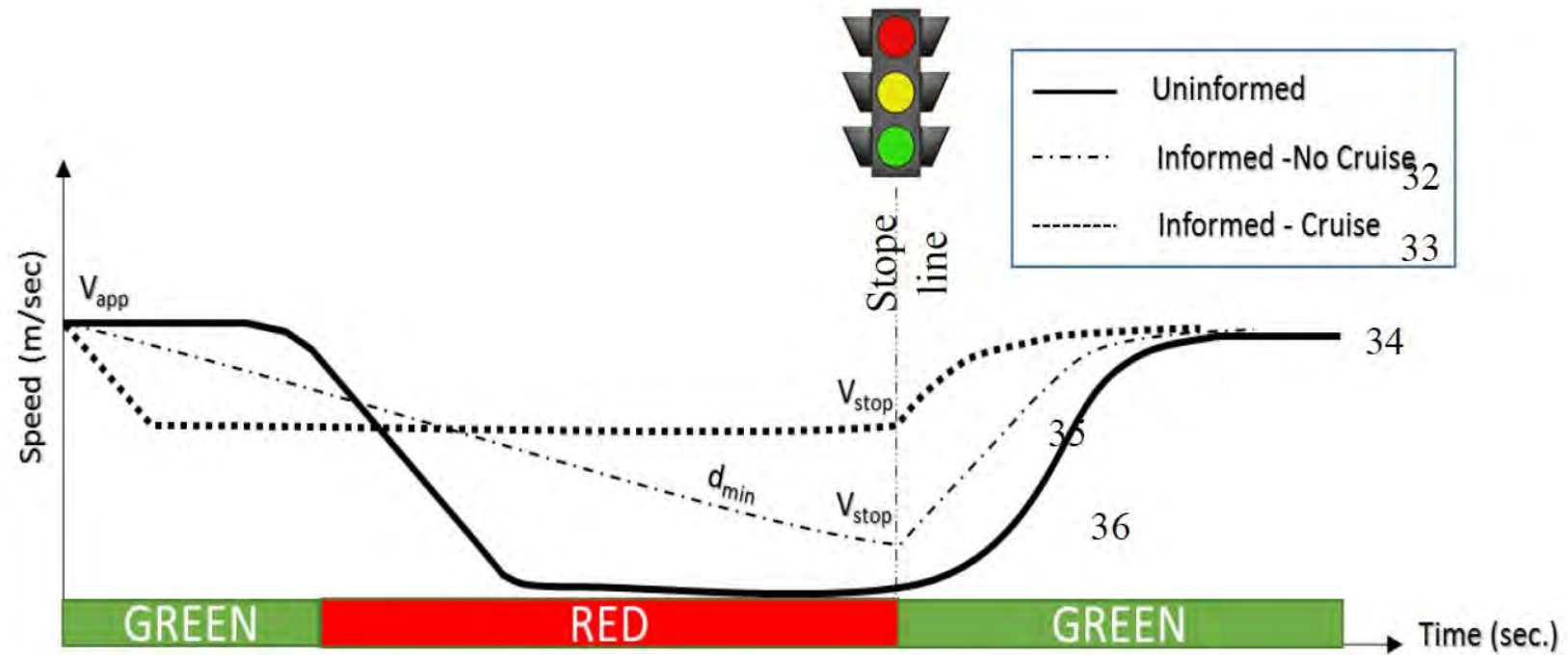
Human-
Centered
Simulation

- AV Automation Malfunction

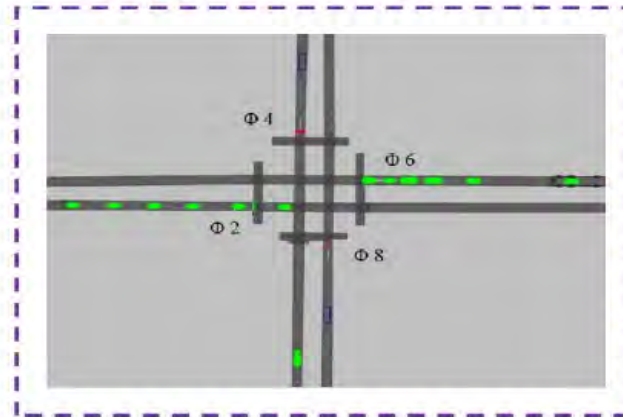
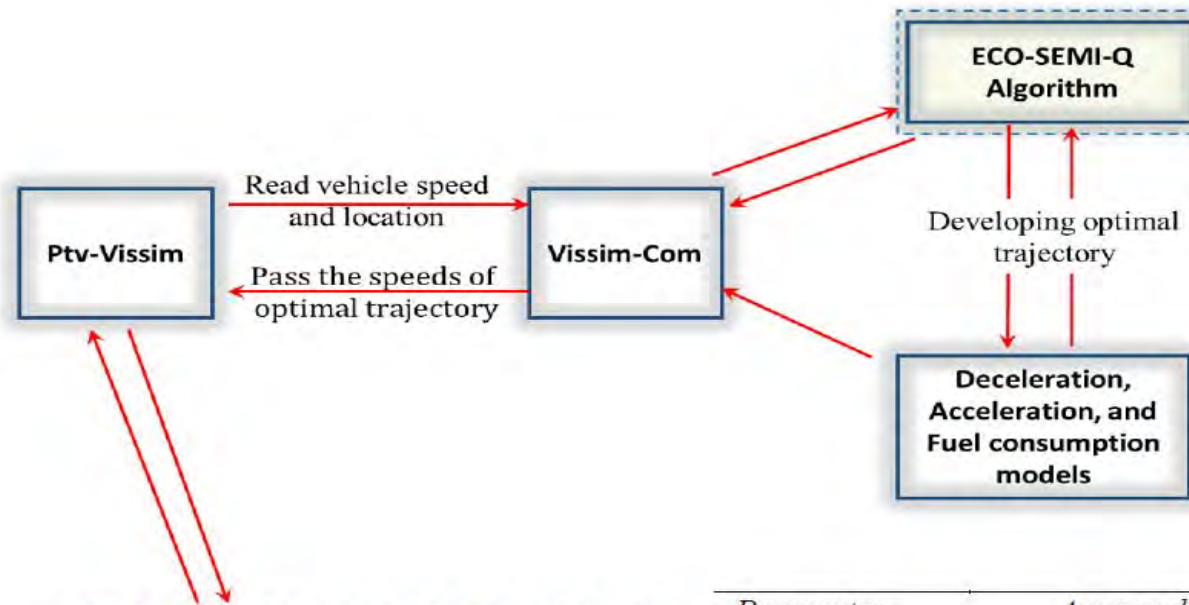


VEHICLE CONNECTIVITY AND ECO- DRIVING

Eco-Driving at Intersections

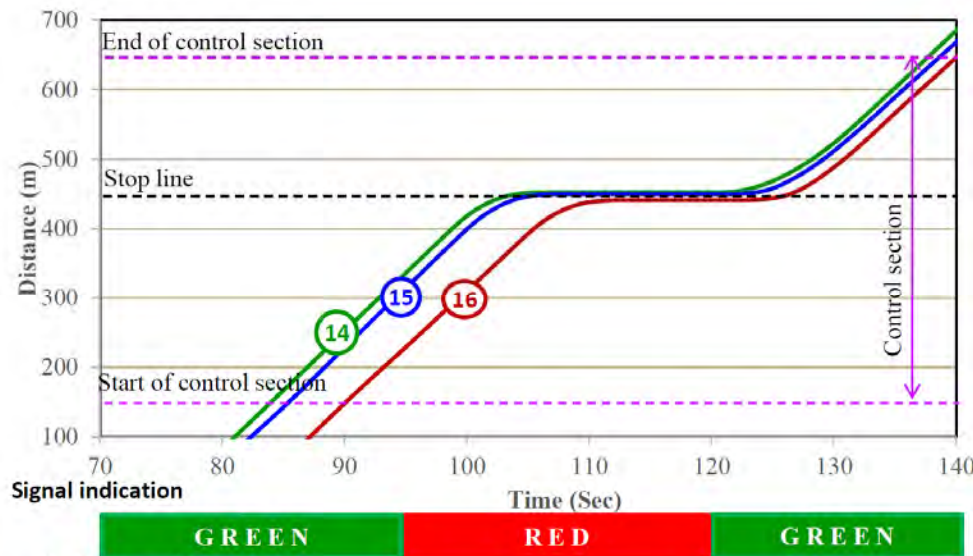


Modeling

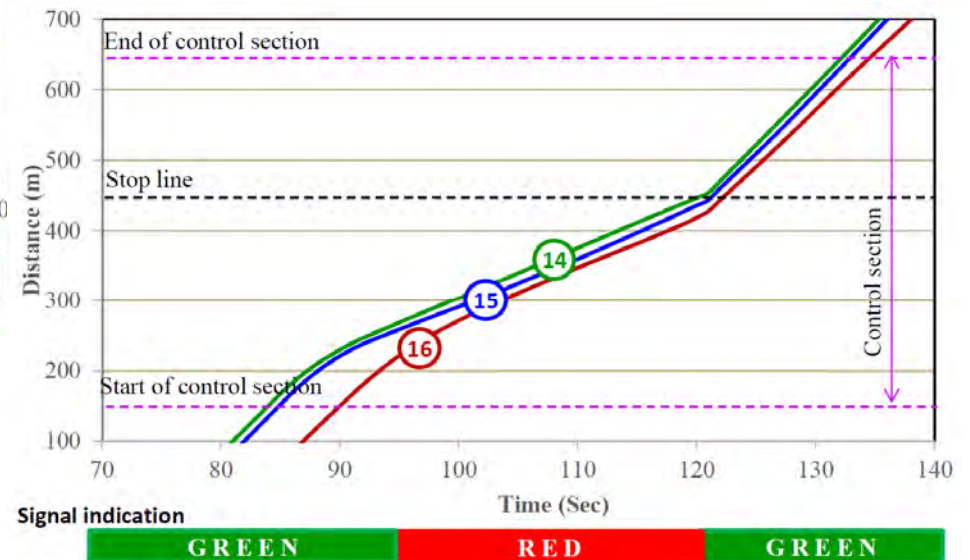


Parameter	Approach	
	Major	Minor
l_{sb}	N.A	25 m
$MinG$	25 sec.	12 sec.
$MaxG$	N.A	20 sec.
λ	N.A	4 sec.
y_{min}	3 sec.	3 sec.
All red	1 sec.	1 sec.
Speed limit	60 kph	40 kph
Demand	600 vph	400 vph
Length	450 m	450 m

Results

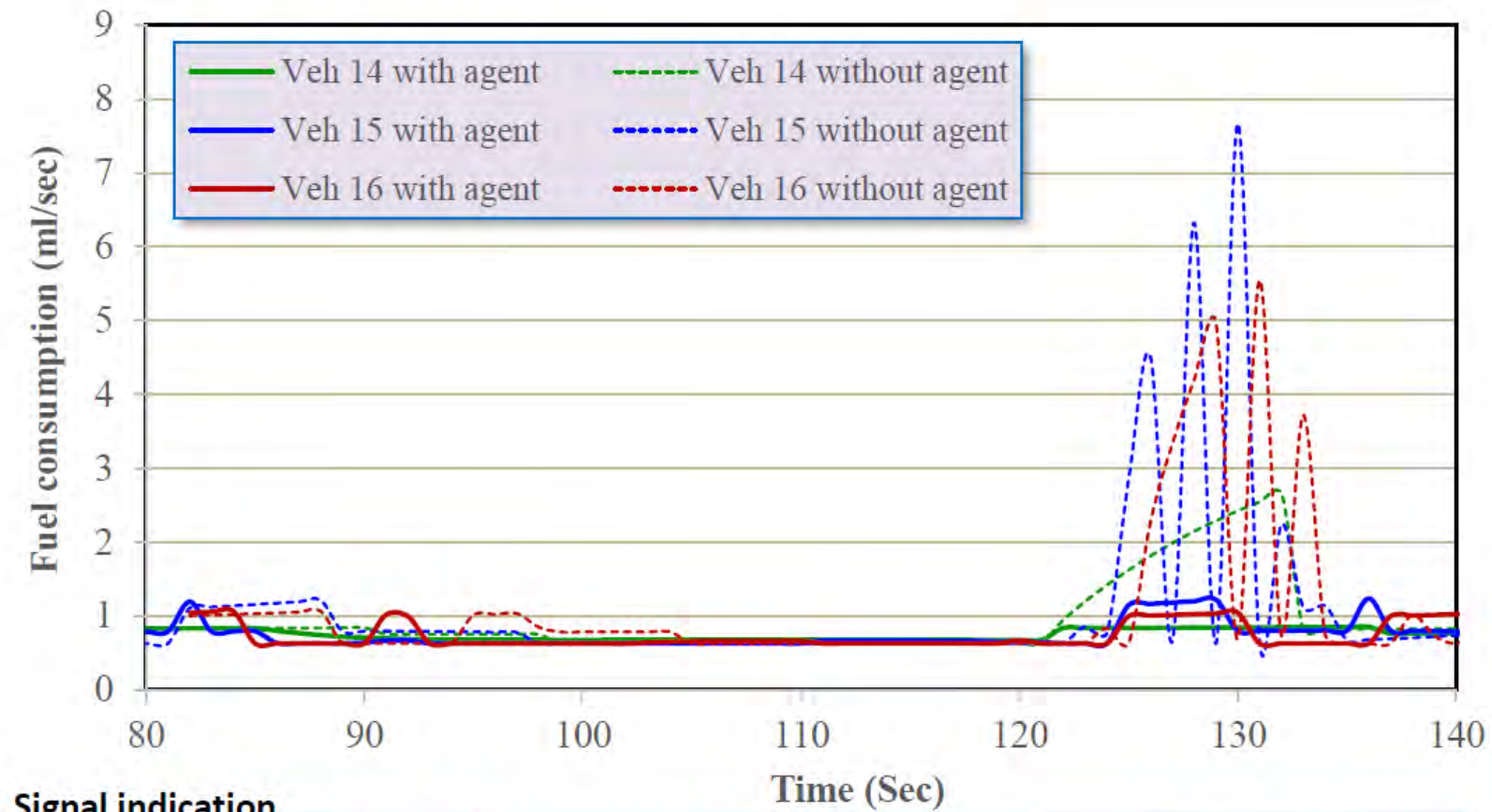


a) Case 1 – Not controlled



b) Case 2 – ECO-SEMI-Q

Results

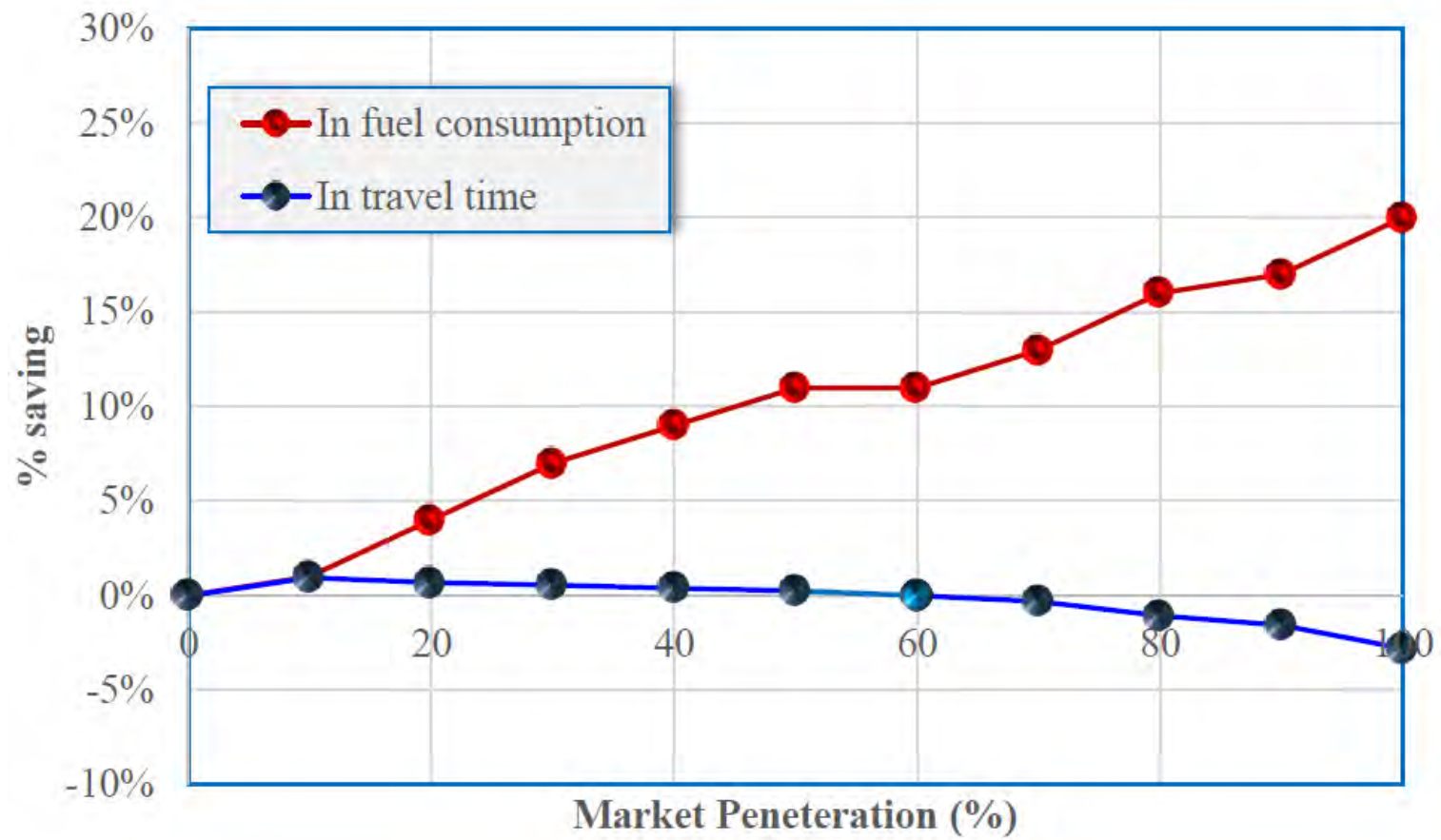


Signal indication



a) Fuel consumption rate

Results



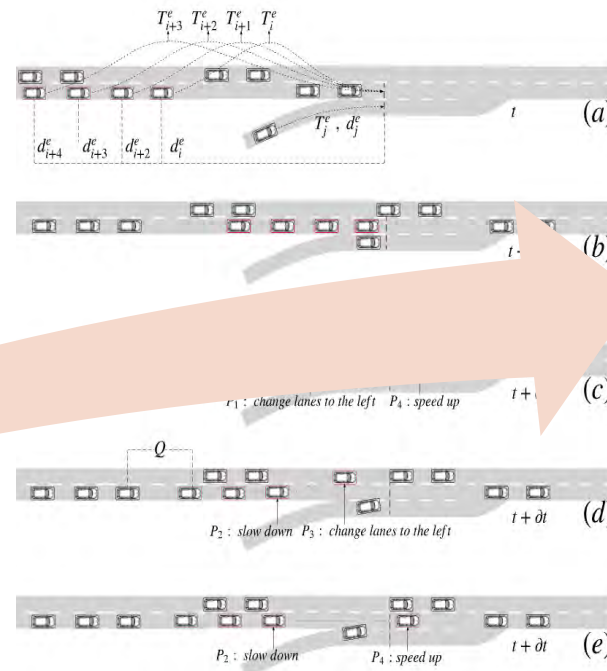
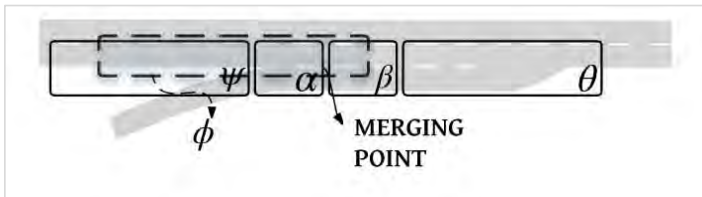


COOPERATIVE DRIVING AUTOMATION

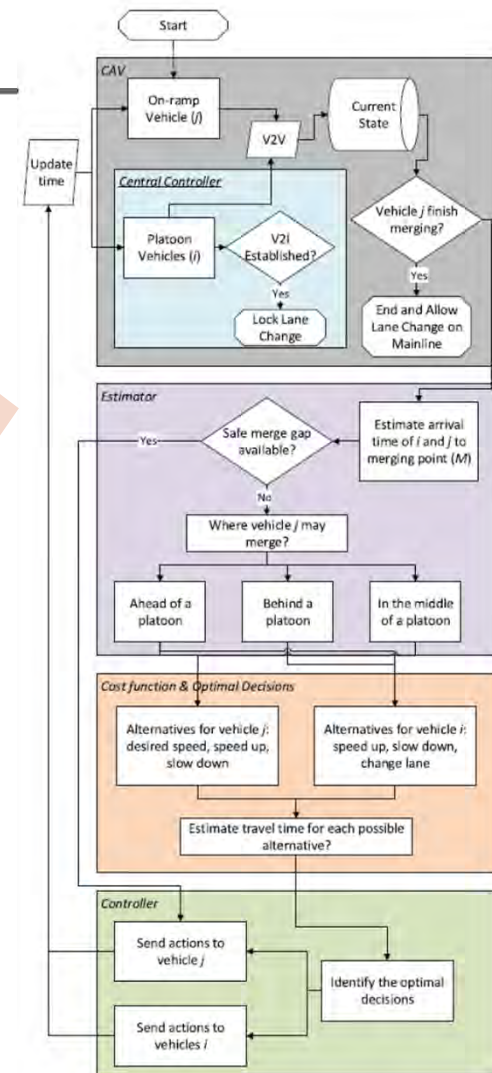
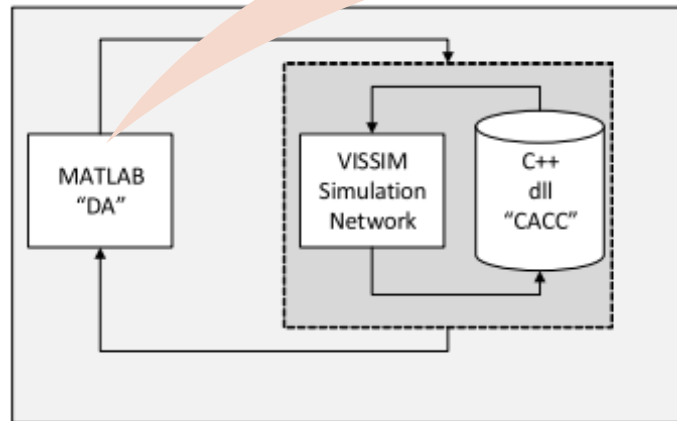
Platooning and Cooperative Driving



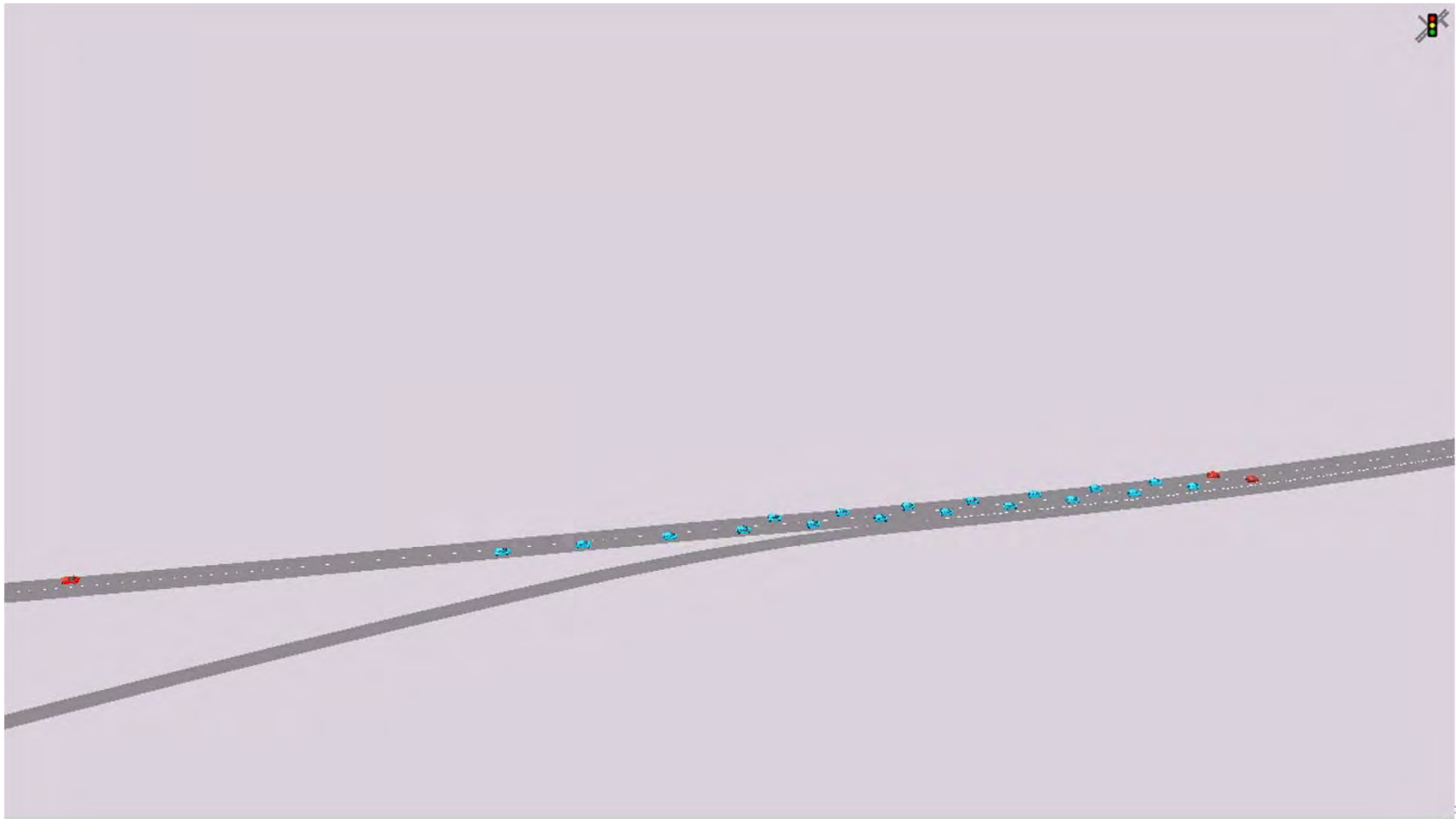
Simulation Model



$$vehicle(i) \in \begin{cases} \psi, \\ \alpha, \\ \beta, \\ \theta, \end{cases} \quad \begin{aligned} &tt_j^e - tt_i^e \geq t_{lag_{cr}} \\ &0 \leq tt_j^e - tt_i^e < t_{lag_{cr}} \\ &0 \geq tt_j^e - tt_i^e > -t_{lag_{cr}} \end{aligned}$$



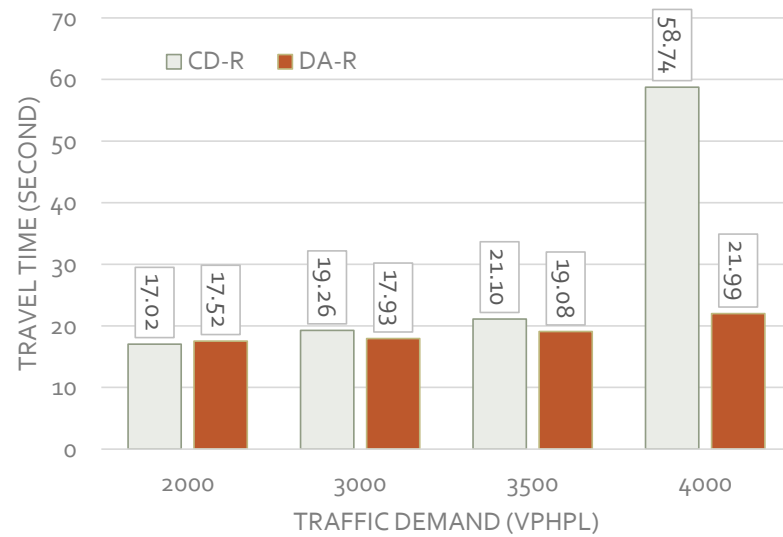
Simulation Model



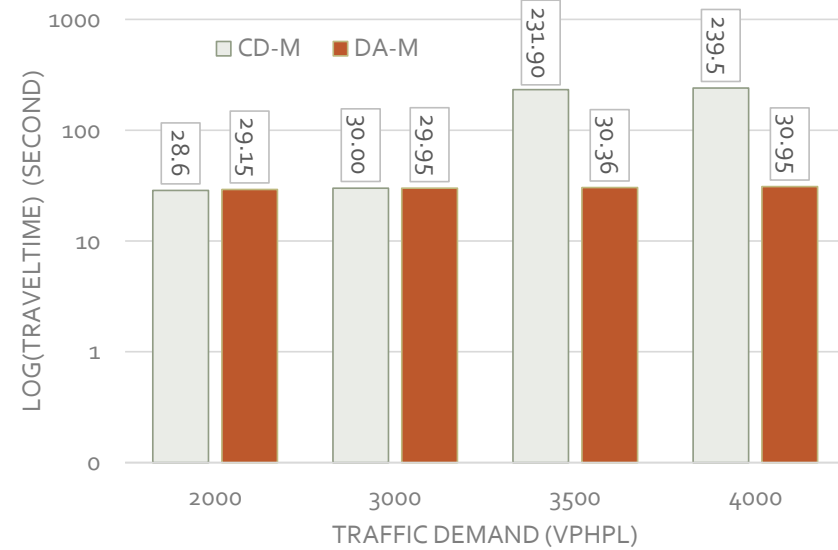
Results



On-Ramp Travel Time



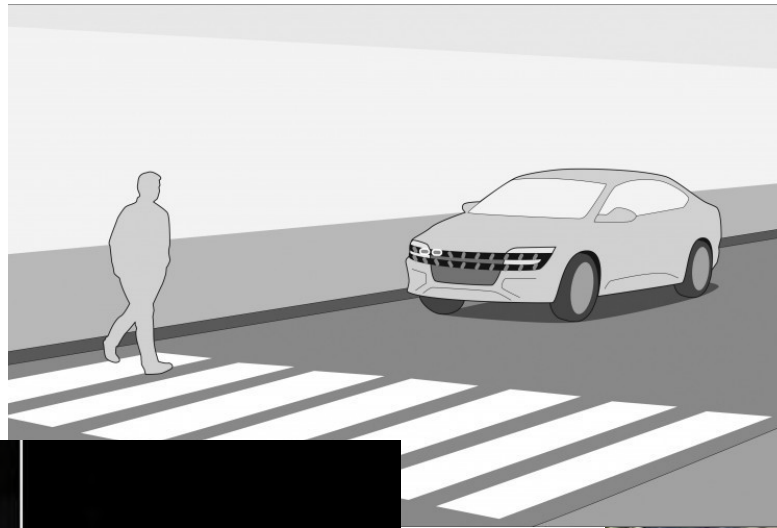
Mainline Travel Time





USER INTERACTION WITH AUTOMATION

Autonomous Driving and Human Interaction



Simulation Environment



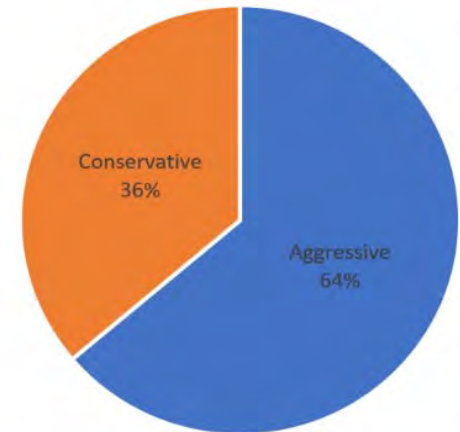
- **Four-lane divided roadway – Two lanes/direction**
- **Speed limit 70 mph**
- **Three malfunctions before entering curves**
- **Auditory Alerts**



Participants and Experiments



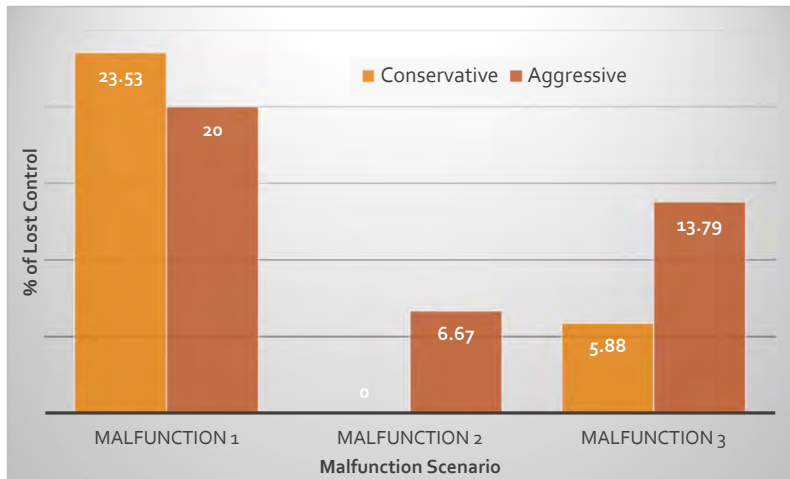
- 47 participants
- Pre-Experiment Questionnaire
 - Larson Driver's Stress Profile (anger, impatience, competition, and punishing behavior)
- Performance Measures
 - Frequency of losing control $|a^-| = g \cdot [.198 (v^2/100) - .592(v/100) + .569] \cdot \cos(\theta)$
 - Frequency of performing unsafe maneuvers while taking over after automation malfunction
 - Type of control when taking over (braking, steering, ... etc)



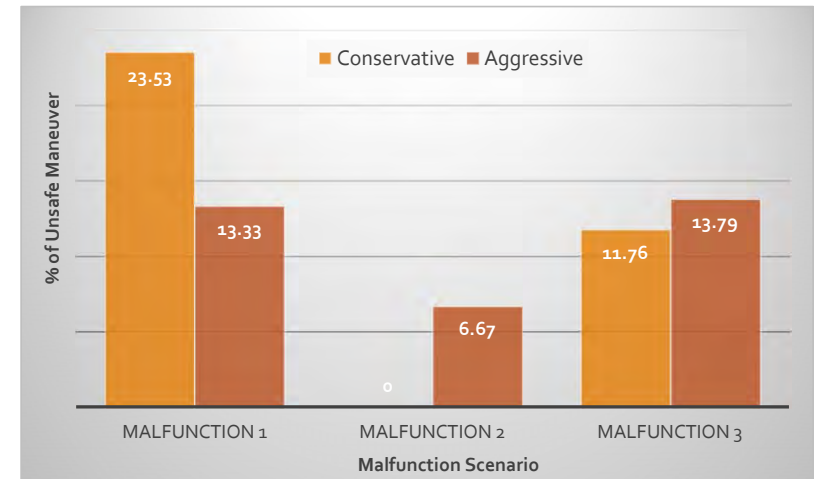
Results



% of Drives with Lost Control



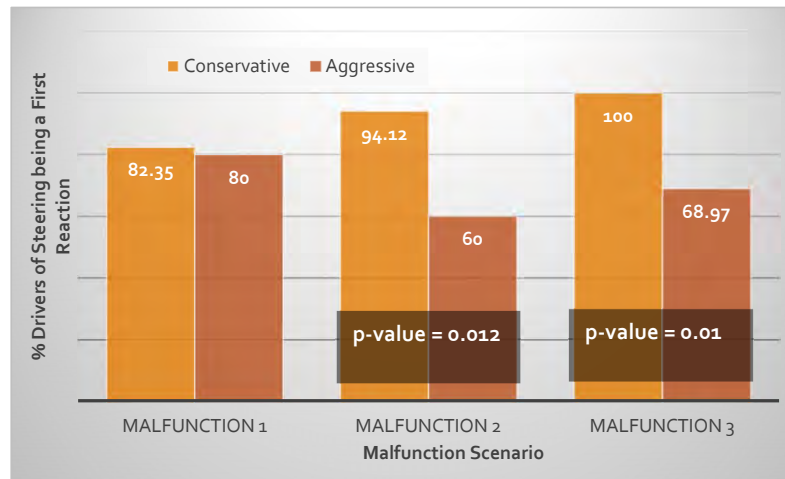
% of Drives with Unsafe Maneuvers



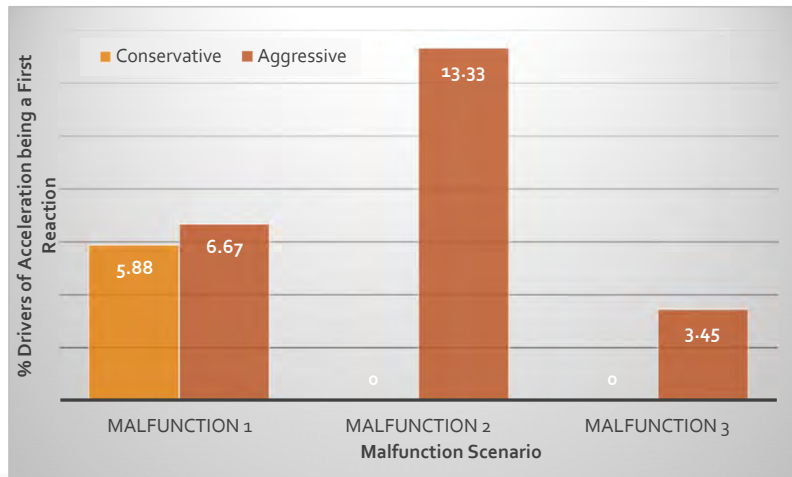
Results



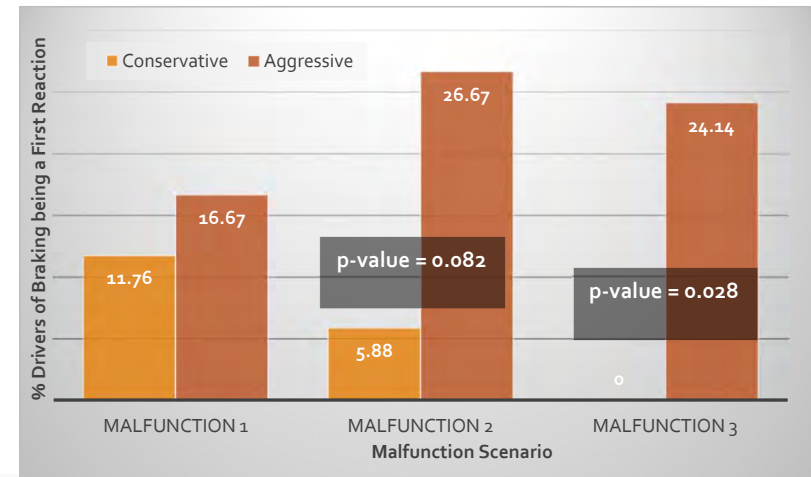
Steering



Acceleration



Braking





RECAP AND FINDINGS

Recap and Findings

- **Transportation system is highly complex and dynamic**
- **Many emerging challenges that require effective tools to understand the system behavior and propose solutions**
- **Simulation tools have long been utilized – many have been introduced with pros and cons**
- **Reliance on basic features of simulation tools may not always be feasible**
- **With the aid of simulation:**
 - **Understand impacts of vehicular technologies on the system**
 - **Identify whether realizing benefits would come with a cost, hence a trade-off may be needed**
 - **Test and refine innovative algorithmic designs**
 - **Incorporate realistic human perspective in non-destructive experiments**
 - **Understand and analyze various psychophysiological aspects and their impacts on safety and operation**
- **It is important to have clear questions to identify and understand the needs (level of fidelity, what layers to add, what tools to use, ... etc.)**



Questions & Comments

Osama-osman@utc.edu



Clarke Chauvin
ITS, LLC

DOTD's DSRC Pilot for Connected Vehicles

SimCap Louisiana Chapter Meeting

Dec. 8, 2020

Presented by: Clarke Chauvin, ITS LLC



History of Connected & Autonomous Vehicles (CAV)

Autonomous



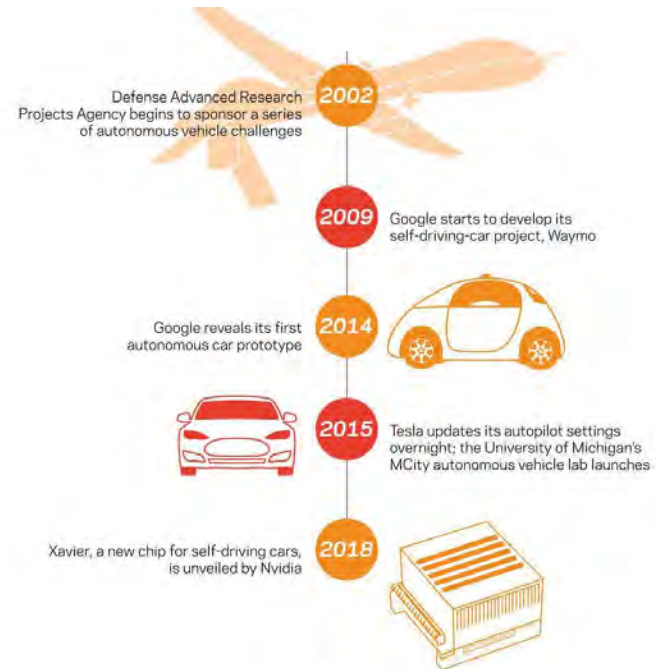
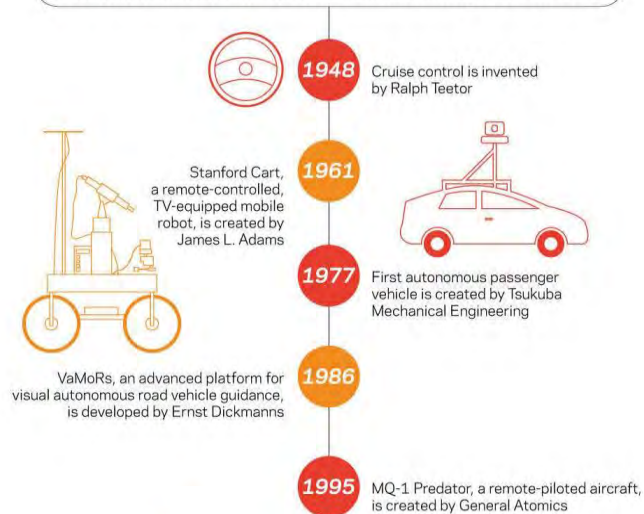
Connected



History of Connected & Autonomous Vehicles (CAV)

Getting Out of the Driver's Seat

Autonomous vehicle development throughout history



Sources: "10 Major Milestones in the History of Self-Driving Cars." *Digital Trends*, Feb. 2019.
"A Brief History of Autonomous Vehicle Technology." *Wired*, Aug. 2016.

History of Connected & Autonomous Vehicles (CAV)

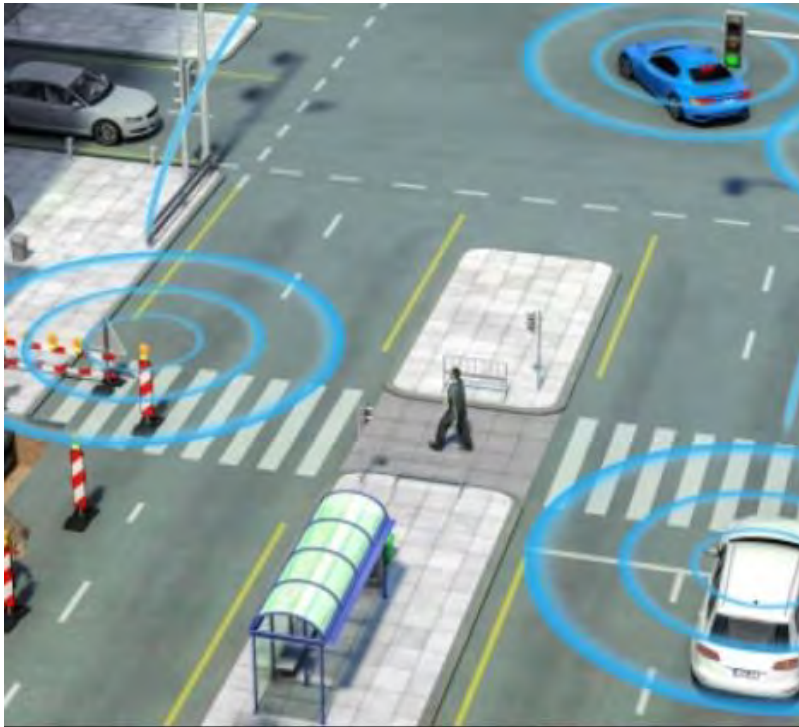
DSRC

- * Dedicated Short Range Communications
- * FCC allocated bandwidth
- * 2017 Cadillac CTS sedan first mass produced with DSRC
- * Well received by global automakers

5G LTE

- * 5th Generation Long-Term Evolution cellular communication
- * Prevalent with cell phones
- * Greater interoperability, wider bandwidth

Dedicated Short Range Communications (DSRC)



- * In 1999, US allocated 75 MHz of 5.9 GHz band to be used by ITS
- * In June 2017, Utah DOT demonstrated DSRC with a bus system
- * In November 2020, FCC reallocated 45 of the 75 MHz to not be reserved for ITS

Why should I care?

- * Reduced congestion, travel times, and increased safety through
 - * Improved platooning
 - * Live traffic updates & rerouting
 - * Respond to incidents before they can be seen

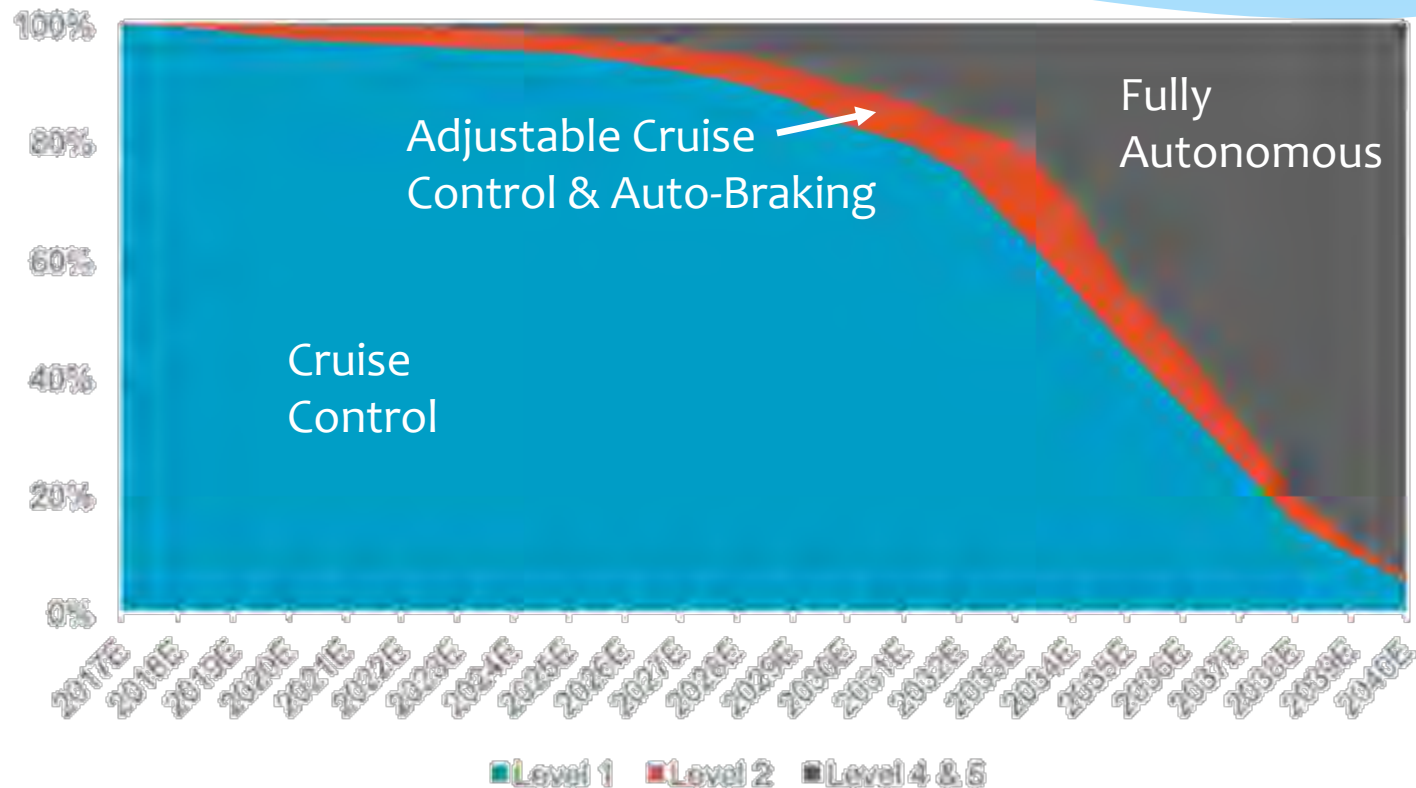


Why should I care?

- * This is SimCap Louisiana
 - * You are interested or working with roadway capacity
- * Many Louisiana roadways are above capacity
- * It's our future and it's pretty neat!



CAV Market Penetration Estimate



DSRC Pilot Project



Planned 5 DSRC units along Airline Hwy in Baton Rouge



~3.25 miles



Provide live SPaT data to drivers and fixed points for DSRC

Bluetoad Spectra RSU



DSRC antennas for V2X communications

Bluetooth antennas for traditional travel time detection

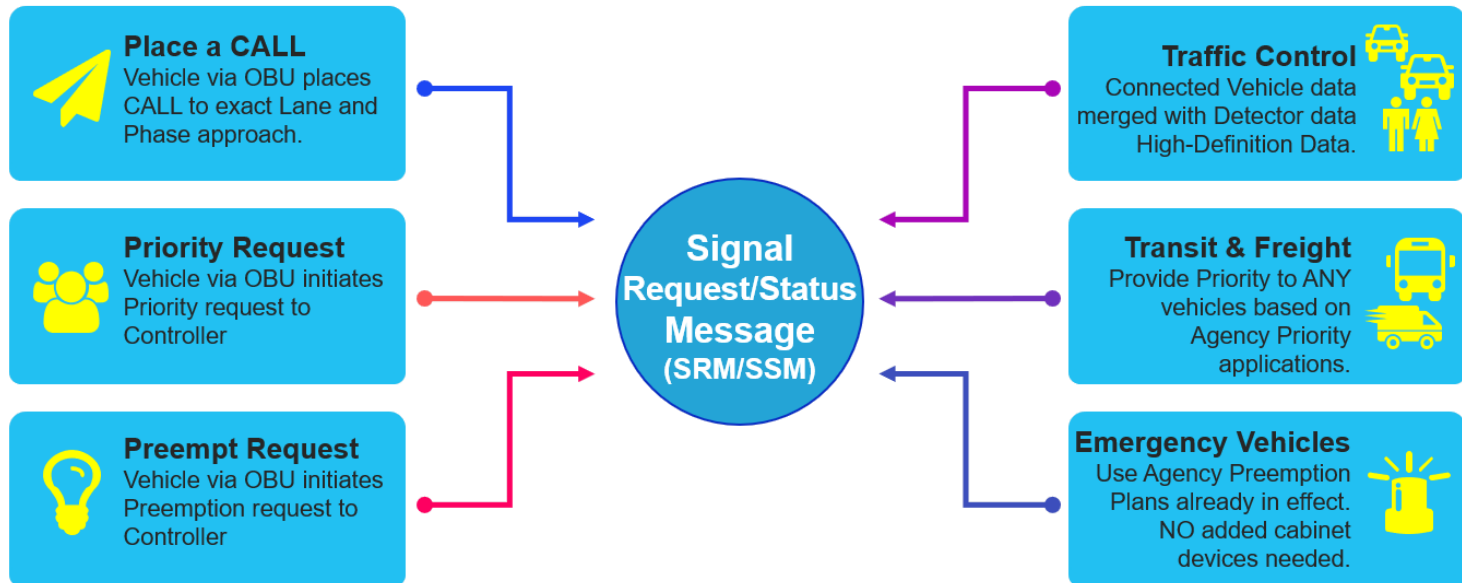
Bluetoad Spectra RSU

Vehicle Basic Safety Message (BSM) Data Aggregation



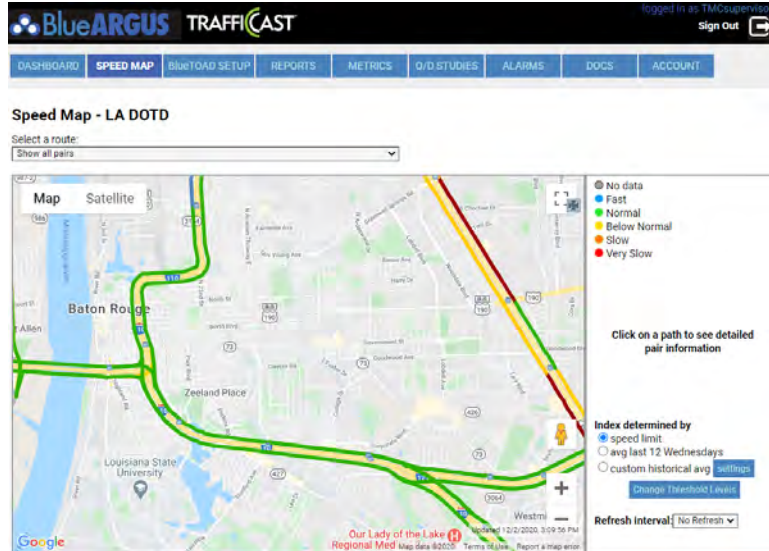
Bluetoad Spectra RSU

Signal Priority Applications to Increase Traffic Flow...



Bluetoad Spectra RSU

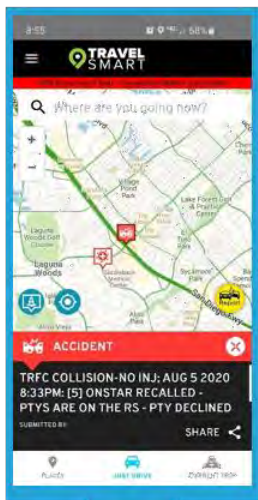
BlueARGUS Software Suite



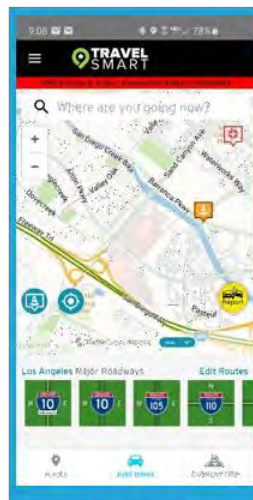
- * TrafficCast hosted Cloud solution
- * Web-based GUI with unlimited users
- * 3 Main components:
 - * Simple setup of pairings and routes
 - * Real-time information and alarms
 - * Historical Reports and Analysis
- * Over 3,500 BlueARGUS Users Worldwide

TravelSmart App

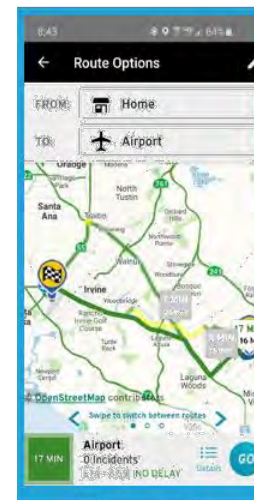
TravelSMART Smartphone Mobile App



Incidents



Routing

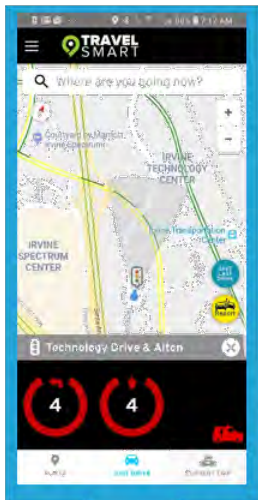


Navigation

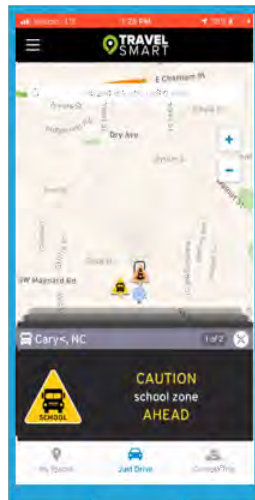


TravelSmart App

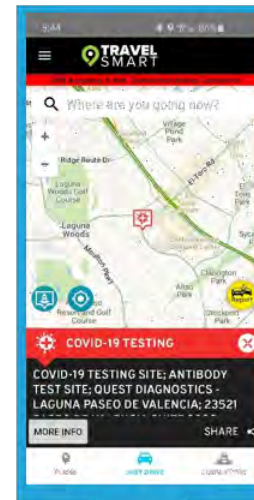
TravelSMART Smartphone Mobile App



**I2X
Information**



**Localized
TIM**



**Public
Service
Announcements**



The diagram illustrates the BlueARGUS system architecture, which integrates mobile applications, DSRC communication, and traffic signal infrastructure. At the top, a cloud labeled **BlueARGUS** is connected to a **Traffic Network**. The network is linked to a **Traffic Signal Cabinet** containing a **Trafficware Controller**, an **Ethernet Network Switch**, a **Ped/Cycle Detector Processor**, and a **TrafficCast CV App Processor**. A **Ped/Cycle Detector** is mounted on a pole next to a traffic light, connected to the processor in the cabinet. A **DSRC** (Dedicated Short-Range Communications) system is shown with a **BlueTOAD Spectra RSU** (Road Side Unit) on the pole and an **OBU** (On-Board Unit) on a car. A dashed blue line represents the DSRC communication link between the RSU and the OBU. The OBU is also connected to a **CELL** (cellular network) and a **TravelSMART iOS/Android App** on a smartphone. The app is linked to a **TrafficCarma Public Mobile App** which handles **SPaT, TIM, PSM (Personal Safety Message)** and **Ped and Cycle Detection Display Manager**. The entire system is designed to provide real-time traffic information and safety alerts to mobile users.

Installation



Installation



Installation

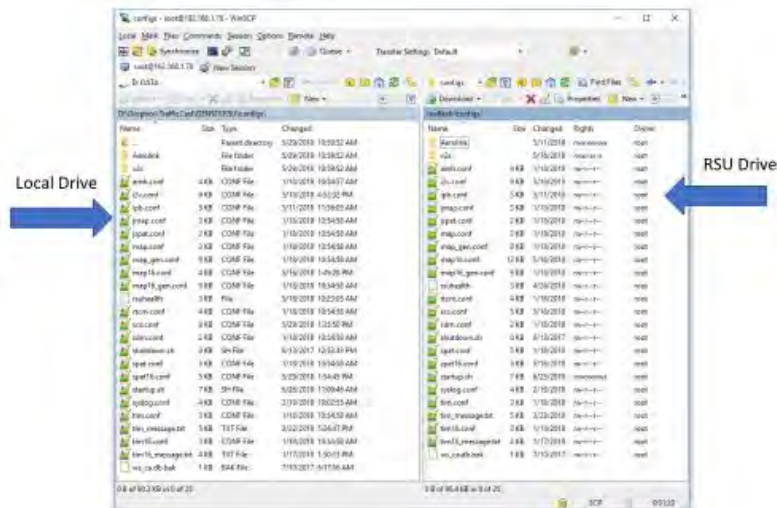


Configuration



Configuration

- * Configuration tool not ready
- * Rewrote code and uploaded to device
- * Helped TrafficCast develop configuration procedures



Integration



- * Firmware upgrades
- * Controller licensing
- * Definitely did not put signal into flash (oops!)
- * DOTD's security breach in Feb 2020
 - * Local DNS needed

Integration



- * Updated firmwares
- * DOTD's security breach in Feb 2020
 - * Local DNS
 - * Work with OTS to open up firewall

Integration

BlueARGUS TRAFFICAST

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DASHBOARD SPEED MAP BLUETOAD SETUP REPORTS METRICS O/D STUDIES ALARMS DOCS ACCOUNT

Devices Pairs Routes Intersections

Devices - LA DOTD

☒ Show Active Devices ☐ Show Inactive Devices

Map Satellite

Blue Bayou Water Park

Hobart

Map data ©2020 1 km Terms of Use Report a map error

ADD DEVICE
IMPORT DEVICES
FIND DEVICE
JOIN TO DEVICE
GROUP SELECTION
HELP

BlueARGUS TRAFFICAST

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DASHBOARD SPEED MAP BLUETOAD SETUP REPORTS METRICS O/D STUDIES ALARMS DOCS ACCOUNT

Devices Pairs Routes Intersections

Intersections - LA DOTD

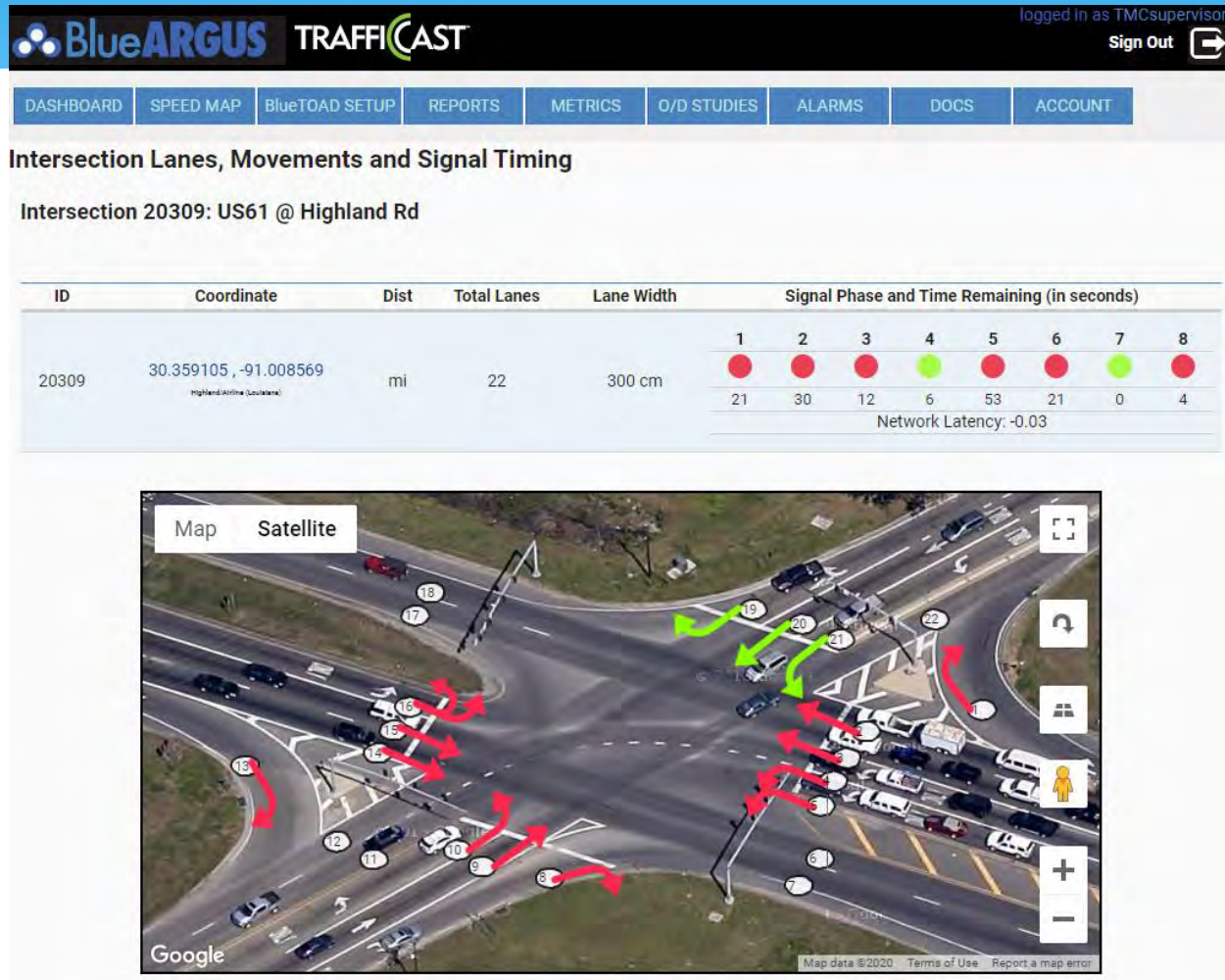
Map Satellite

Blue Bayou Water Park

Hobart

Map data ©2020 Terms of Use Report a map error

US 61 (Airline) at Highland



US 61 (Airline) at Perkins

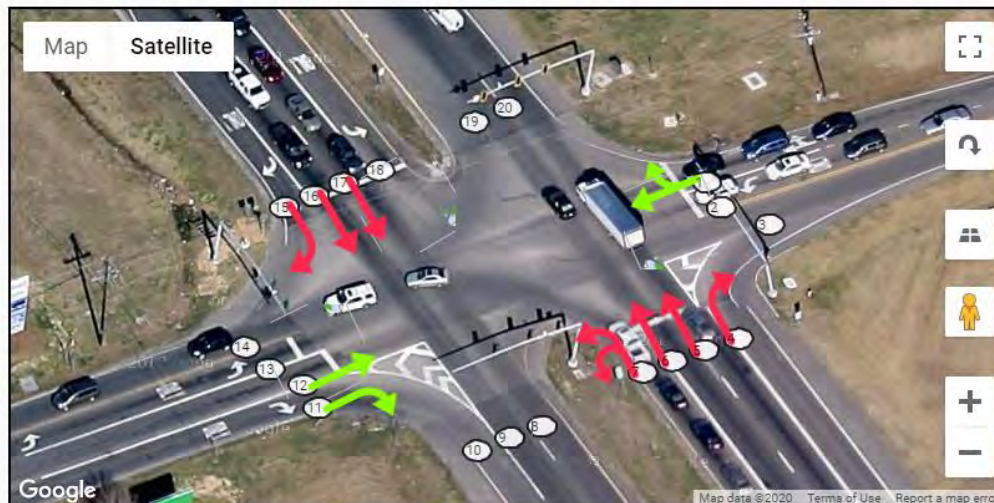
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Intersection Lanes, Movements and Signal Timing

Intersection 18773: US61 @ Perkins Rd

ID	Coordinate	Dist	Total Lanes	Lane Width	Signal Phase and Time Remaining (in seconds)							
18773	30.332972, -90.985360 <small>Perkins/Airline (Louisiana)</small>	mi	20	300 cm	1	2	3	4	5	6	7	8
					30	10	0	3	0	10	0	3
Network Latency: 0.04												



US 61 (Airline) at Wal-Mart

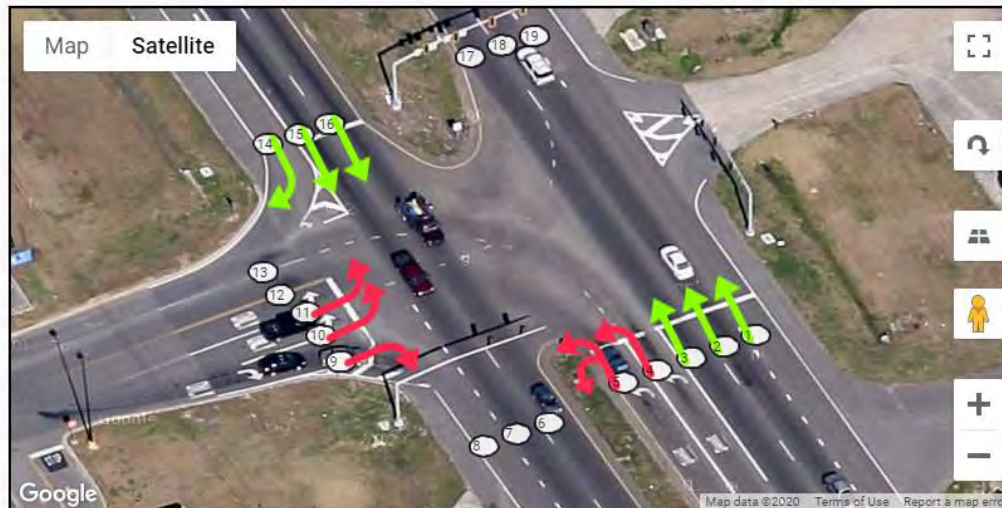
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Intersection Lanes, Movements and Signal Timing


Intersection 12358: US61 @ Walmart Driveway

ID	Coordinate	Dist	Total Lanes	Lane Width	Signal Phase and Time Remaining (in seconds)			
					1	2	4	6
12358	30.330415, -90.983859 <small>Airline Commerce (Louisiana)</small>	mi	19	300 cm	<div><div></div></div> 14	<div><div></div></div> 7	<div><div></div></div> 23	<div><div></div></div> 18
Network Latency: 0.01								



US 61 (Airline) at LA 42





 **TRAFFICCAST**

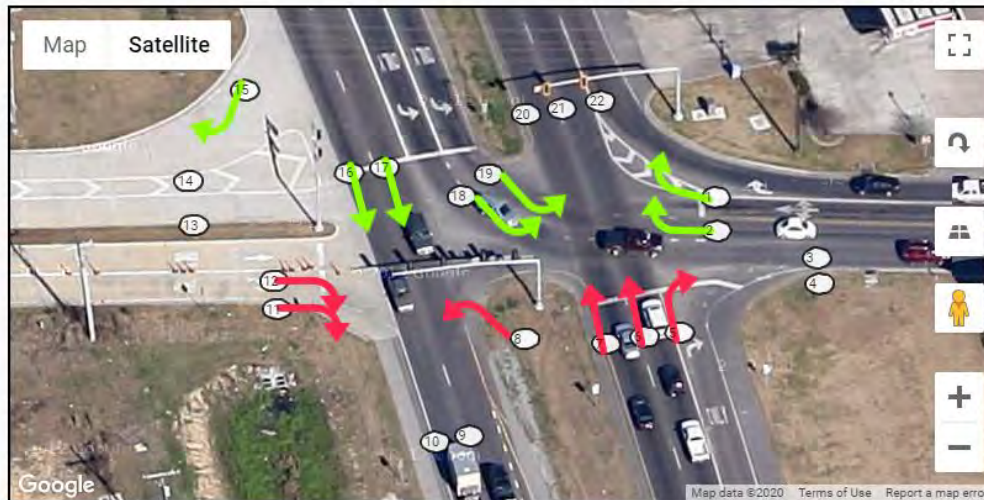
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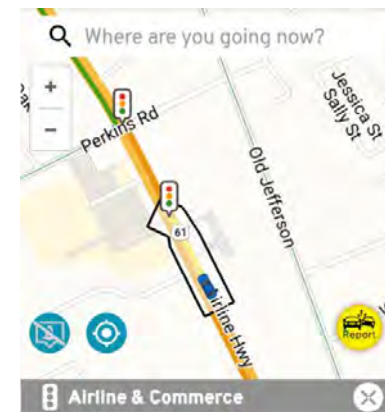
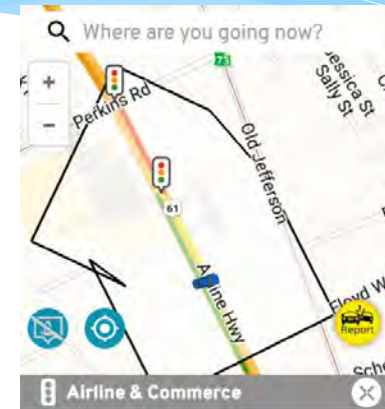
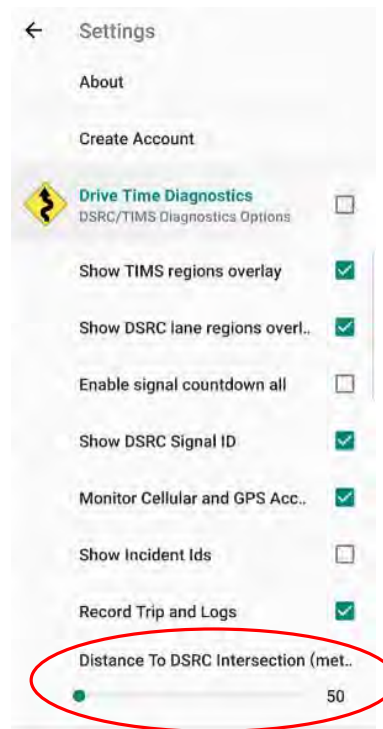
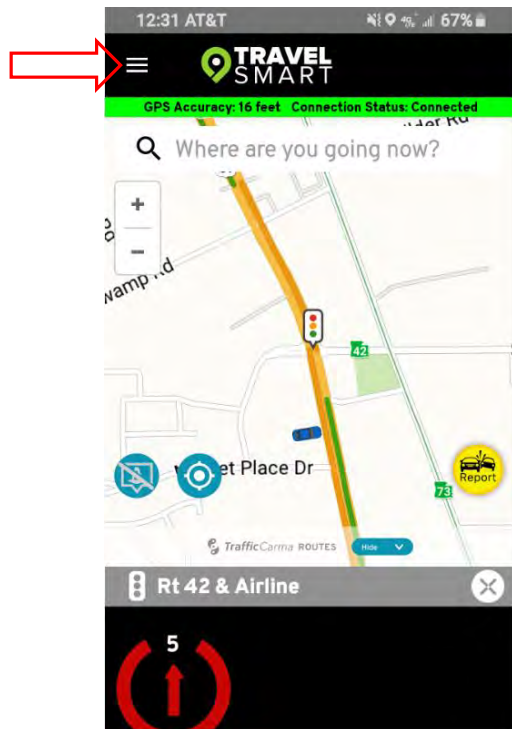
Intersection Lanes, Movements and Signal Timing

Intersection 52238: US61 @ LA42

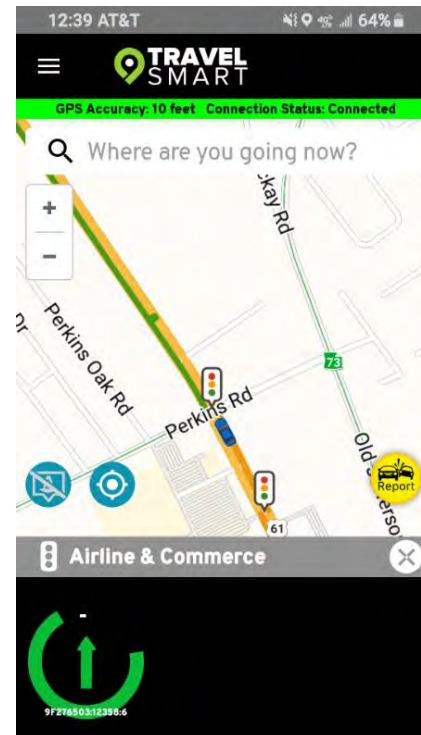
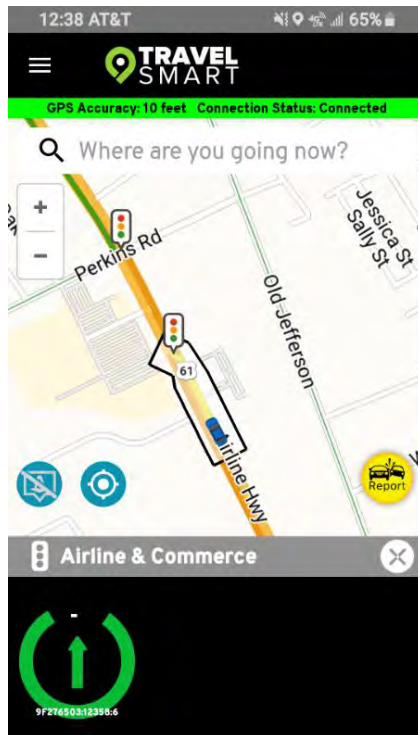
ID	Coordinate	Dist	Total Lanes	Lane Width	Signal Phase and Time Remaining (in seconds)			
52238	30.320445, -90.978271 <small>(Rt 42/Airline (Superior))</small>	mi	22	300 cm	1	2	5	6
								
					41	33	5	11
					Network Latency: 0.03			



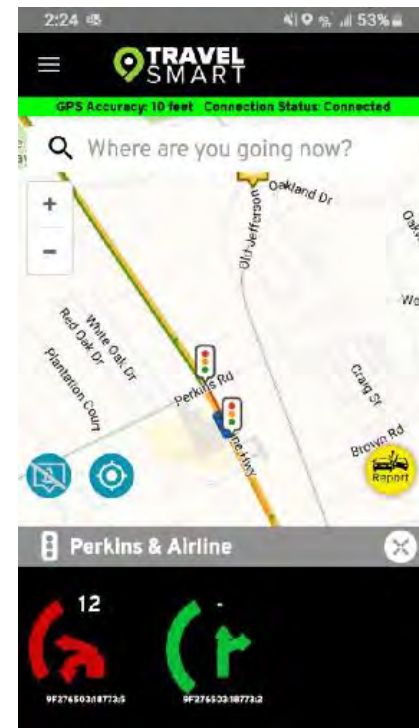
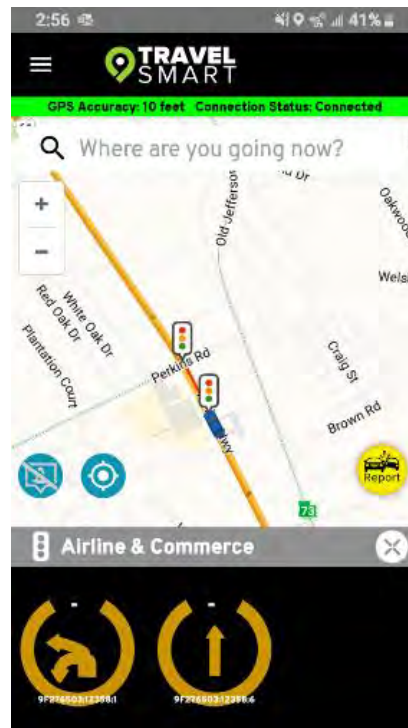
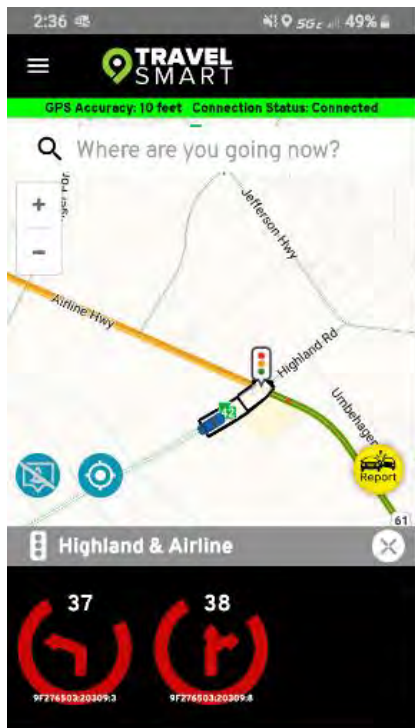
Results: More Troubleshooting



Results: More Troubleshooting

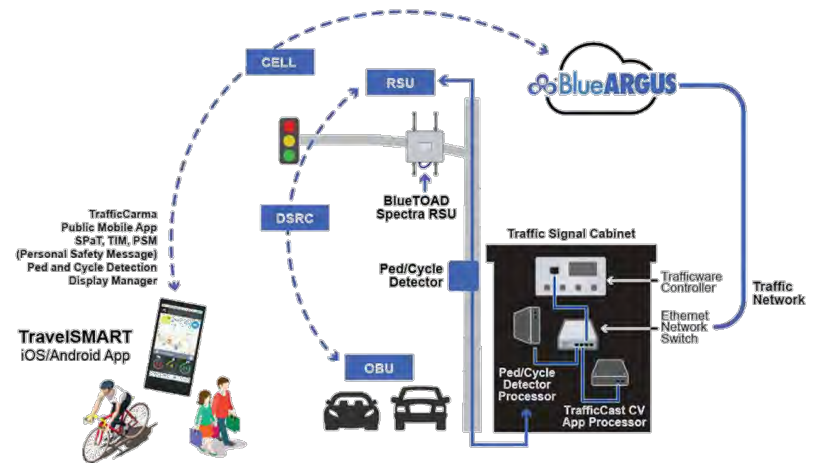


Improved Experience



Summary

- ✓ System fully operational
- ✓ Learned a lot
- ✓ Louisiana's first CV pilot
- ✓ Hopefully more technology is introduced to Louisiana



Questions?

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Thank You for Attending!

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