



TRAFFIC  
TECHNOLOGY  
SERVICES

Delivering the  
traffic signal  
into the cloud...







# What We Are Doing

- TTS is currently deploying a nationwide V2I/I2V system for automotive OEMs, Tier 1s, and other services
- No DSRC equipment is required
- Interface at ATMS, limiting connection points for security and communication redundancy
- Vehicle models in 2017, released in Q3 2016, will support TTS data products



# USDOT Connected Vehicle

- Applications for the Environment: Real-Time Information Synthesis (AERIS) Program
  - Eco-Approach and Departure at Signalized Intersections
  - Connected Eco-Driving
  - Eco-Integrated Corridor Management
  - Dynamic Eco-Routing

## AERIS OPERATIONAL SCENARIOS & APPLICATIONS



### ECO-SIGNAL OPERATIONS

- Eco-Approach and Departure at Signalized Intersections (similar to SHoT)
- Eco-Traffic Signal Timing (similar to adaptive traffic signal systems)
- Eco-Traffic Signal Priority (similar to traffic signal priority)
- Connected Eco-Driving (similar to eco-driving strategies)
- Wireless Inductive/Resonance Charging



### ECO-LANES

- Eco-Lanes Management (similar to ATIS lanes)
- Eco-Speed Harmonization (similar to variable speed limits)
- Eco-Cooperative Adaptive Cruise Control (similar to adaptive cruise control)
- Eco-Ramp Metering (similar to ramp metering)
- Connected Eco-Driving (similar to eco-driving strategies)
- Wireless Inductive/Resonance Charging
- Eco-Traveler Information Applications (similar to ATIS)



### LOW EMISSIONS ZONES

- Low Emissions Zone Management (similar to low emissions zones)
- Connected Eco-Driving (similar to eco-driving strategies)
- Eco-Traveler Information Applications (similar to ATIS)



### ECO-TRAVELER INFORMATION

- AV Charging/Fueling Information (similar to navigation systems providing information on gas station locations)
- Eco-Smart Parking (similar to parking applications)
- Dynamic Eco-Routing (similar to navigation systems)
- Dynamic Eco-Transit Routing (similar to AVL routing)
- Dynamic Eco-Freight Routing (similar to AVL routing)
- Multi-Modal Traveler Information (similar to ATIS)
- Connected Eco-Driving (similar to eco-driving strategies)



### ECO-INTEGRATED CORRIDOR MANAGEMENT

- Eco-ICM Decision Support System (similar to ICM)
- Eco-Signal Operations Applications
- Eco-Lanes Applications
- Low Emissions Zone s Applications
- Eco-Traveler Information Applications
- Incident Management Applications

#### LEGEND

- P** Policy Considerations
- E** Educational Tools
- M** Performance Measures

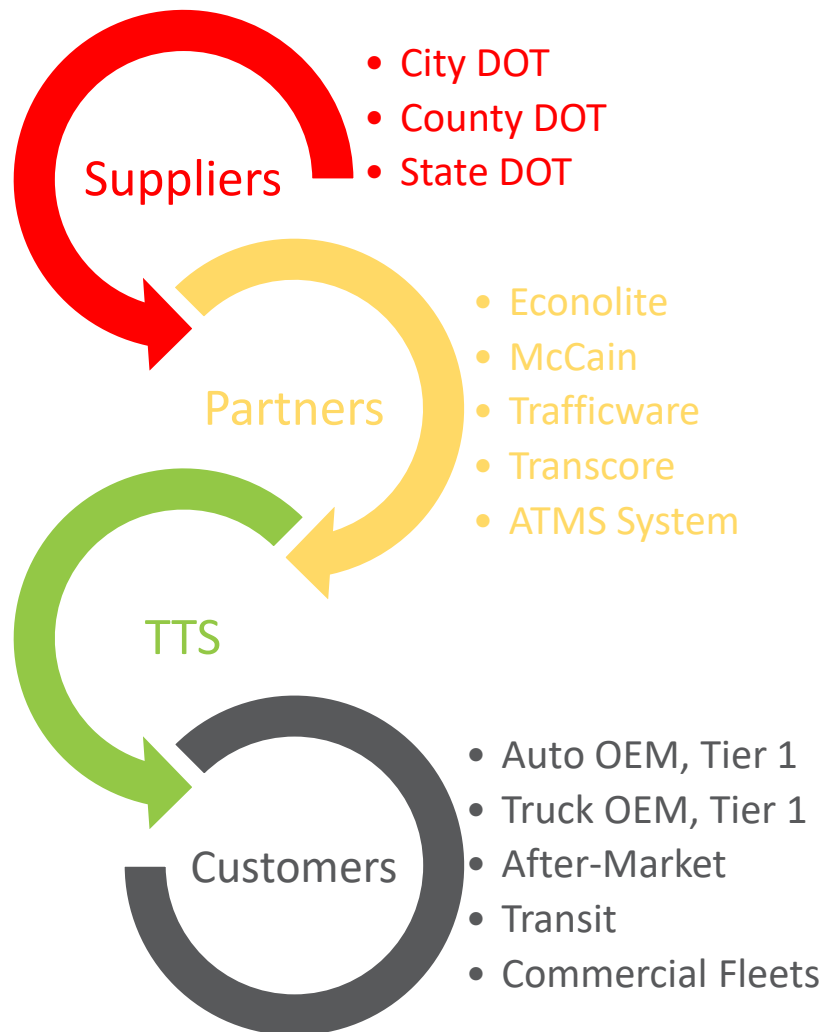
# What is Our Product?

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- Personal Signal Assistant
    - SPaT (Signal Phasing and Timing) message
      - Current signal status
      - Predicted signal switch times
      - Emergency vehicle preemption
      - Protected/permissive operations
    - MAP message
      - Lanes, geometry, stop bar locations
      - Phase assignments
      - Speed limits
    - SAE J2735 protocol, compliant
    - Customers access data via API or other sharing services
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# How Does It Work? Relationships



- Suppliers own data, as by-products of the infrastructure
- Partners deliver the data from ATMS, based on proprietary interfaces, NTCIP, or AB3418E
- TTS connects the systems, develops the information, and delivers the product
- Customers develop and provide the connected vehicle applications

# Data from Suppliers

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- Offline data
    - Signal timing
    - Phasing diagram
  - Real-time data
    - Actuated signals
      - Phase active status (red, yellow, green)
      - Phase call status
      - Preemption or transit signal priority
      - Active timing plan
      - Cycle second
    - Fixed time signals
      - Active timing plan
      - Cycle second
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# Delivery from Partners

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- Our partners deliver data formats based on our specifications or existing API's from their ATMS systems
- We work with leading technology providers, such as:





# Personal Signal Assistant Mechanics



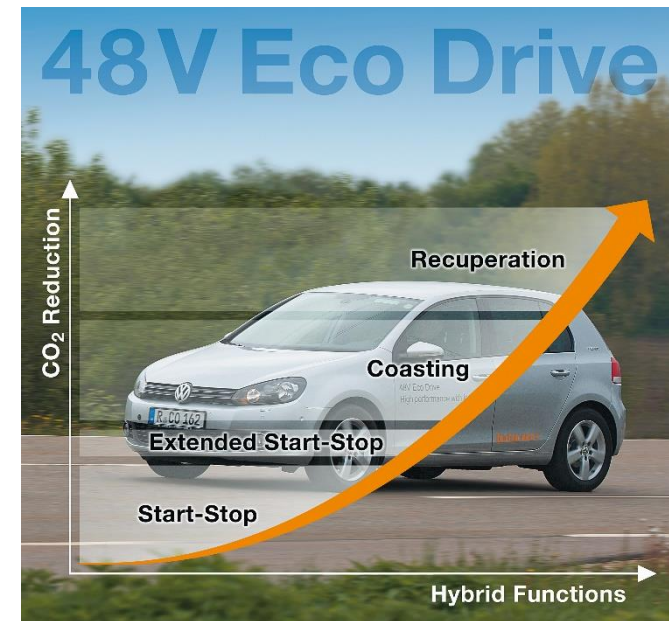
- Proprietary algorithms based on traffic signal control principles & machine learning techniques
- Data fusion techniques
  - Long term:
    - Movement vehicle arrival patterns
    - Day-to-day and time-of-day variations, special events
  - Short term:
    - Immediate vehicle arrival patterns
  - Current:
    - Signal state
    - Phase call
- Output
  - Next two switches for each signal
    - Time to green
    - Time to red

# The End Result



# Continental Application Example<sup>2</sup>

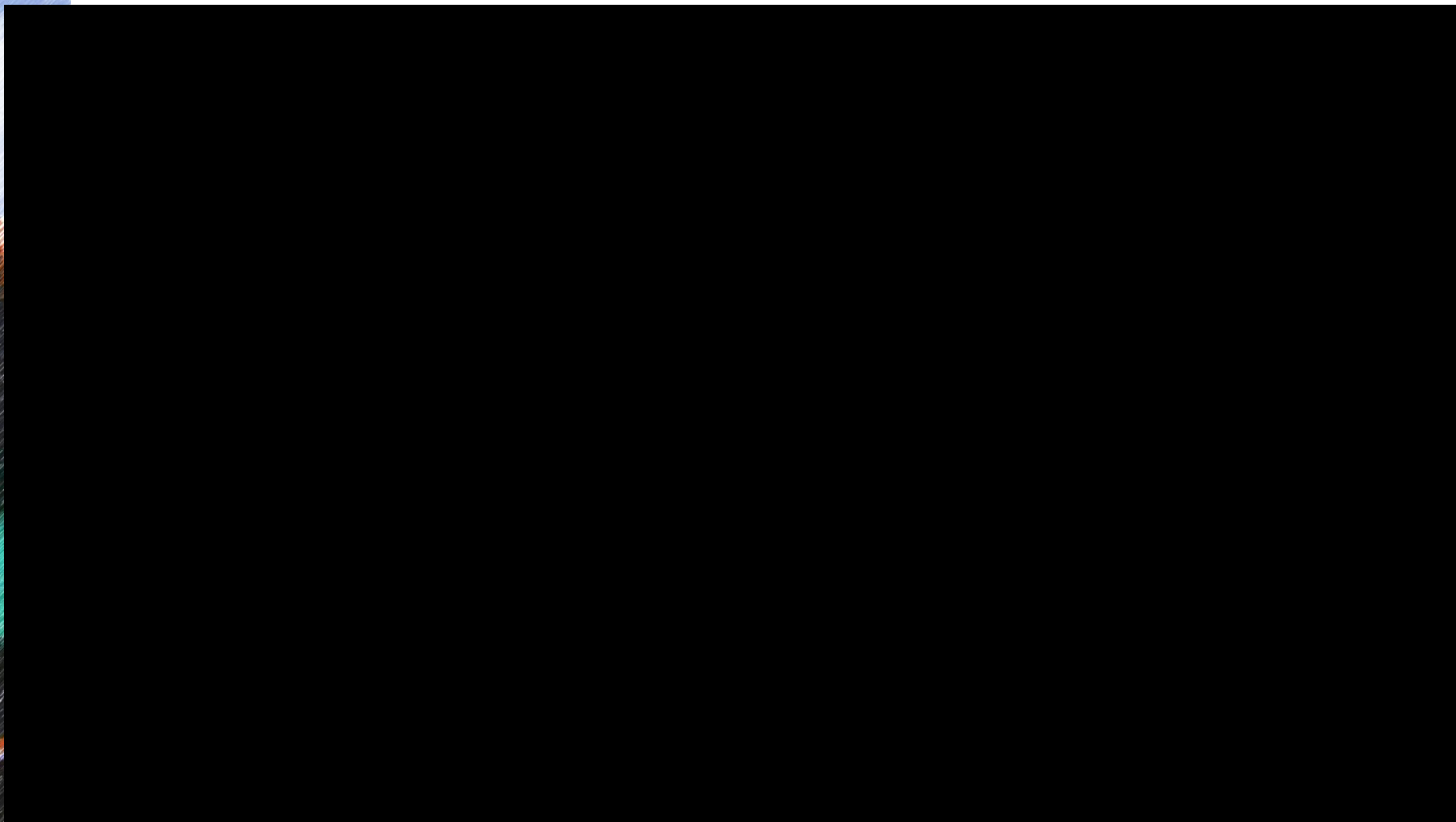
- Approach on red
  - Automatic Recuperation
    - Recuperation/regeneration of brakes automatically applied
    - Suggestion by system to apply brake
    - Integrated into start-stop system, 1 second before green
- Approach on green
  - Coasting
    - If slower speed would be more efficient, the accelerator pedal vibrated



<sup>2</sup> As implemented by Continental for CES 2016.

# The End Result

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# Agency Benefits

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- Supplier Portal
    - Live Feed of Personal Signal Assistant
      - Time to green, Time to Red predictions
    - Log Files
    - Signal Operations Reports
      - Communication downtime
      - Time in offset seeking
      - Detector faults
      - Max times
    - Signal Performance Reports
      - Delay
      - Number of stops
      - Arrivals on green/red
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# How to Get Started

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- Review and execute data licensing agreement
    - Permission to access and use signal timing data
    - Signal timing plan documents or data
  - Work with ATMS vendor or consultant
    - Accommodation of minimal hardware at TMC per recommendation by ITS / ATMS vendor
    - Internet Service Provider if necessary
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# Thank You!

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