

# Personal Signal Assistant



TRAFFIC  
TECHNOLOGY  
SERVICES



## Who is TTS?

Traffic Technology Services Inc., TTS, is a Connected Vehicle data content provider for the automotive industry, automotive OEM, commercial fleets, telematics integrators, and other transportation services and providers. TTS includes a team of experienced professional traffic engineers and computer scientists who know how your systems work and understand traffic operations. TTS is incorporated in Delaware and headquartered in the Portland, Oregon area.

## What is the Product?

The product, Personal Signal Assistant (PSA), is a predicted and time-calibrated state of the traffic signal for use in third-party applications.

TTS uses your data to provide the added-value prediction and time calibration of the original signal timing state as provided from the traffic controller. Traffic signal controllers do not deliver a predicted state, which is desired by our customers to implement into their telematics and in-vehicle information systems.

PSA provides an industry-standard Signal Phasing and Timing (SPaT) and MAP message as a deliverable to the customer. Information provided in the message varies by customer, but always includes PSA information on the predicted state.

We do not provide a Mobile application to the consumer market, we are solely a data content provider.

## How Does It Work?

We communicate to your signals that are on a network and capable of real-time communication for actuated signals, and possible less than once every cycle for fixed time intersections. We use standards such as AB3418E and NTCIP to provide the necessary information from the traffic signal controllers. We can communicate to the signals directly, or through your preferred ATMS vendor, to our cloud-based servers.

The specific communication workflow can be summarized as:

- Communication from signal controller hardware to ATMS (Closed Network)
- Communication from ATMS to TTS servers (IP)
- Computations for PSA product (Cloud-Based)
- Communication from TTS to Third-Party Servers/Applications (IP)

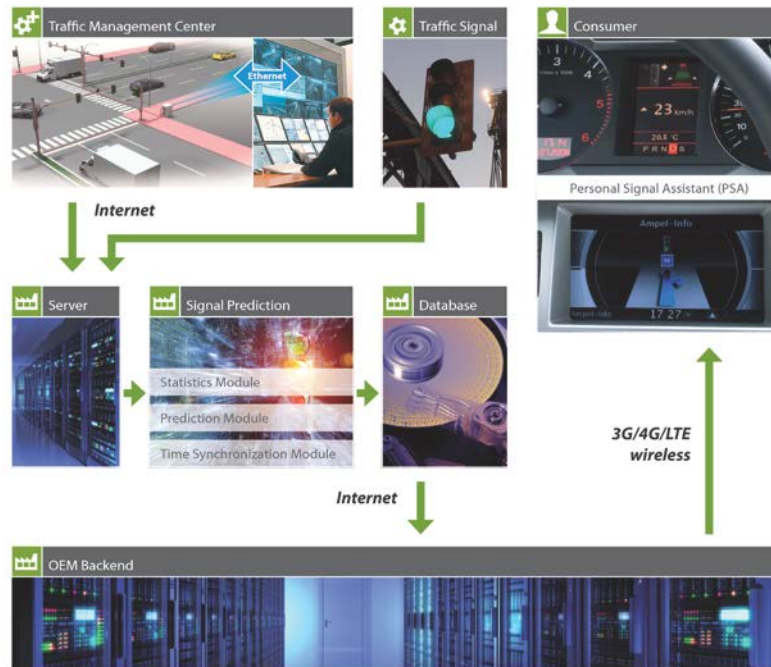


Figure 1. System architecture and data flow of the online signal state prediction system (PSA)

## Who Are the Customers?

TTS has two customers in the automotive industry, Audi and BMW, and is negotiating with other interested automotive OEM and other parties. Our business plan envisions customers in the automotive industry, commercial fleets, and other ATIS providers.

## How is the Product Used?

Our customers use the PSA to provide information in their existing human machine interface or in-vehicle display. The biggest motivation for the automotive industry is to tie the vehicle auto start-stop feature with PSA to improve the intelligence of these systems. There are also safety applications by using the PSA data.



Figure 2. Examples of in-vehicle human machine interface (HMI) designs that present traffic signal data to drivers: (a) red countdown dial or speed advice together with navigation display in the central control (BMW) (b) red countdown timer or speed advice on digitalized dashboard (Audi).

### Audi Implementation

Audi has implemented PSA into their Traffic Light Info Online (TLIO) service as part of their driver assistance systems and Car-2-X applications. TTS worked with the signal managing jurisdiction in Las Vegas, F.A.S.T., and Audi to demonstrate the PSA technology at the Consumer Electronics Show 2014, which won awards for new automotive technology by The Verge:

<https://www.youtube.com/watch?v=1yidKIC1yKQ>

### BMW Implementation

BMW is currently implementing PSA into the BMW apps. TTS is working with NJDOT along NJ Route 1 to demonstrate the PSA technologies.

## Why Does TTS Need Your Assistance?

TTS relies on public agencies to provide the initial and ongoing real-time data from the traffic controllers in our proprietary processes and algorithms. Without the assistance of the public agencies, information would need to be gathered from other sources, such as DSRC, which will take decades to implement on a system-wide basis for our customers. Our technology is proven and available to implement today for Connected Vehicle applications.

Our customers desire an 80% deployment of the PSA technology throughout a metropolitan area. Each agency contributes to the overall goal and has significant or critical intersections in the deployment area, thus we want to use your data, regardless of how many intersections your agency manages.

## What Is Required?

First, we need your permission to have access to and use your data. Here are basic steps to get your agency online:

- Identify agency lead contact and preferred signal/ATMS vendors,
- Review and activate authorization agreement for traffic signal data access,
- Demonstrate system online to key-decision makers or other stakeholders,
- Define long-term operations and maintenance plan for system.

## What is the Liability to the Agency?

The liability exposure to the agency by allowing access to this data is no more than the current exposure experienced in the field by drivers or transportation end users. TTS will be producing a product that is used for predictive signal state changes, in addition to understanding the current signal state, and implemented by our customers in the manner that does not reduce or compromise the operator safety.

### Liability Mitigation -

- Current applications by the OEM are to provide assistance to the driver without adding any distraction. This is accomplished by providing the information in formats developed by human factors professionals by the OEM. The direct integration of the information into the MMI is overseen by NHTSA and the OEM.

- Example application by Audi is to hide the time to red countdown timer during the last few seconds to force driver to look at the signal state and not rely specifically on the displayed counter.
- Speed limit or speed suggestions are provided based on the navigation services information, or other OEM technologies, that does not contribute or provide motivation for speeding. For example, if TomTom provides information about the link speed, that is used as the suggested speed when arriving on green or a reduced amount when arriving on red.
- Data licensing with TTS will protect the agency from all claims arising from use of the PSA product. TTS will ensure agreements with customers are specific to hold harmless the original data providers.

## How Do You Protect Access to the Network?

TTS will work with the agency IT staff, or the desired ATMS contractor/vendor, to provide necessary IT security of data access and allow for one-way or read-only communication from the ATMS to the TTS servers. If necessary, firewalls and encryption will be used to protect data communication. TTS does not require to send commands or data packets directly to the signal controllers, therefore not adding any additional security concerns for existing communications between the ATMS and signal controller.

If desired by the agency, TTS will secure an internet service provider to communicate between the ATMS data server/container over public IP. Therefore, TTS would not utilize existing internet service providers to the agency, removing any communication risk to internal agency networks.

## What If I Get a Similar Request From a Different Company?

While TTS will be working directly with the desired ATMS contractor/vendor, and developing proprietary data communication policies for our systems to work most efficiently, this data may still be available to other parties if desired by the agency. TTS will incur all costs initially to develop, setup, and maintain access to the data server. If desired by the agency to share data to other systems, TTS and/or the ATMS vendor will work with the other parties to share expenses at the time of request. In no way shall the agreement between the agency and TTS be construed as preventing other data vendors from accessing similar data.

## What Does This Cost?

There is no direct financial cost associated with the PSA system. TTS will incur any cost associated with working with the ATMS vendor and ongoing maintenance. We ask initially for your time to review necessary documents and identify how to initiate the communication between the agency and TTS. In exchange for your time and access to the data, we are offering system performance metrics which can be utilized to set benchmarks for traffic system operations.

In the future we also envision a business model that will reward participating agencies, either through direct revenue sharing or via a grants specifically for traffic signal systems.

## What's the Benefit for the Agency?

There are multiple benefits available to agency through a partnership agreement. TTS will be providing direct, tangible benefits to the agency with a fully operational system, and addressing indirect benefits to the transportation end users.

### GIS -

TTS will be providing a GIS of all signals in the agency jurisdiction that is necessary for PSA implementation. This data may have other value to the agency, either integrating into the ATMS, other tools, or having as secondary inventory.

### Performance Metrics –

TTS will deliver to the agency, on a regular and fixed interval, information on the performance of the signals based on information received from our customers' fleet. Examples of some performance metrics will include: number of stops, arrivals on red/green, movement delay, pedestrian delay, etc. Further, basic communication metrics from the signals, such as downtime, mode of operations (flash), detector fails, will be summarized in intersection reports. TTS will work with the ATMS vendor to determine value added reports that do not duplicate existing reporting capabilities.

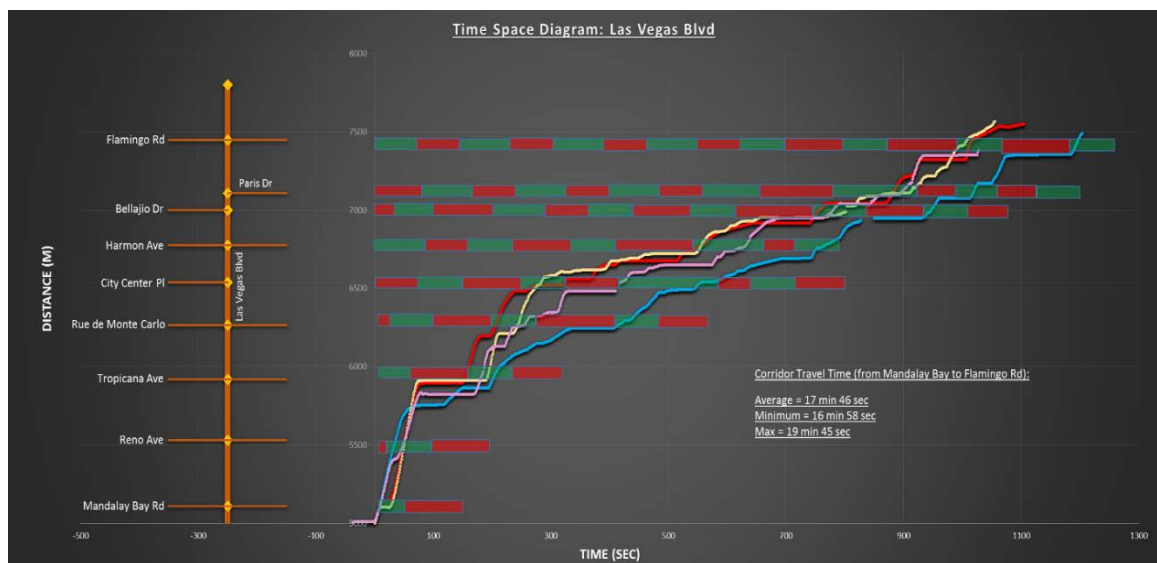


Figure 3. Example of Connected Vehicle data collected in Las Vegas pilot study.

### Public –

The PSA product can be used as safety applications, mobility applications, and environment applications, as stated from the ITS JPO Connected Vehicle Research:

*... the capabilities to test applications that will have the potential to save lives and provide continuous real-time connectivity among users.*

*Safety applications will have the potential to reduce crashes through advisories and warnings. For instance, vehicle operators may be advised of a school zone, sharp ramp curve, or slippery patch of*

*roadway ahead.*

*Mobility applications will provide a connected, data-rich travel environment based on information transmitted anonymously from thousands of vehicles that are using the transportation system at a particular time, which can help transportation managers monitor and manage transportation system performance.*

*Environment applications will provide travelers with real-time information about traffic congestion and other travel conditions to help them make more informed decisions that may result in their taking alternate routes or public transit. This can help make their trip more fuel-efficient and eco-friendly.*

- See more at:

[http://www.its.dot.gov/factsheets/connected\\_vehicle\\_testbed\\_factsheet.htm#sthash.9FS8GTmf.dpuf](http://www.its.dot.gov/factsheets/connected_vehicle_testbed_factsheet.htm#sthash.9FS8GTmf.dpuf)

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### Safety –

Specifically, the PSA product as implemented by customers will have the ability to improve safety by providing information about the signal state status when direct line of sight is not available, such as following a high profile vehicles. PSA will also contribute to safety benefits by providing some indication when approaching the end of a green and reducing the dilemma zone problem. Further, suggested speed indications when approaching a signal state have the potential to reduce stop-and-go traffic conditions by optimizing the platoon arrival to the signal, providing safety benefits by reducing time to collision values.

### Mobility –

A direct output from the end users will be performance metrics for the agency, mentioned above.

The PSA product by its very nature will contribute to a data-rich travel environment, providing more information to the end users about the traffic system. For example, in crowded spaces having supplemental information about the signal state will contribute to more awareness of the signal state and thus compliance. PSA and related products will contribute to ATIS connected vehicle applications.

### Environmental –

Applications utilizing the PSA will be able to implement eco-approach and departure at signalized intersections, connected eco-driving, eco-speed harmonization projects, and dynamic eco-routing applications, as defined by the ITSJPO for connected vehicle deployments. Specifically, Audi has utilized PSA to implement an eco-approach and departure at signalized intersections by activating the start-stop feature with PSA data, contributing to as much as a 15% reduction in carbon emissions based on Audi studies.

## How Can We Get Started?

Contact us at [info@traffictechservices.com](mailto:info@traffictechservices.com) to begin the process. Let's get your traffic signals online!

# Personal Signal Assistant...

*...bringing the traffic signal into the vehicle...*

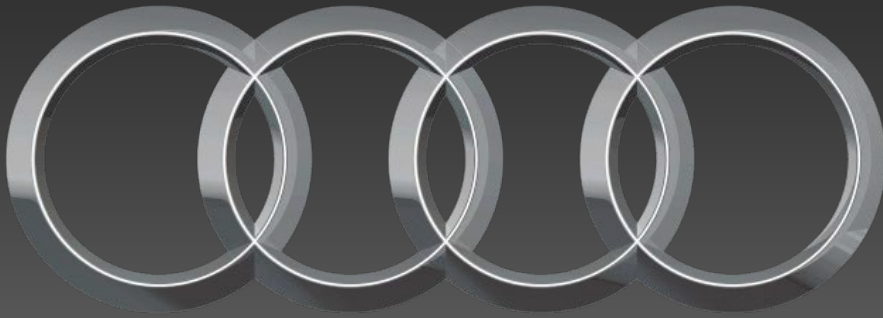




# Traffic Technology Services

- Technology firm specializing in data content for Connected Vehicle applications and services
- Expert team of traffic engineers, data scientists, and programmers
  - Global subject matter expert reputation
  - Inventors of patent-pending technology
- Shareholders include Heusch Boesefeldt, outside investors, and employees
- Incorporated in Delaware with headquarters in Portland, Oregon

# Our Customers



**Audi**

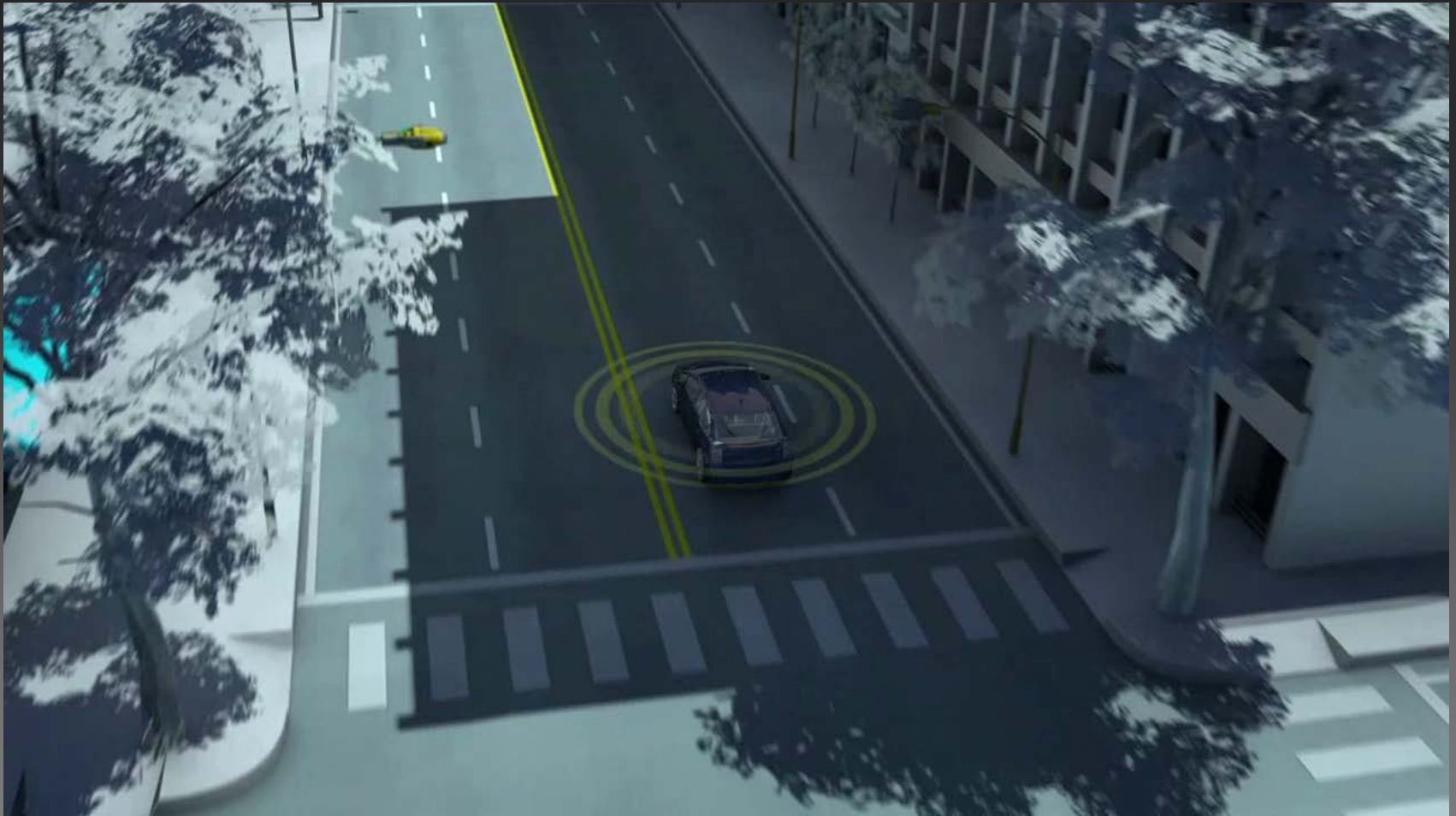


# USDOT Connected Vehicle

- Applications for the Environment: Real-Time Information Synthesis (AERIS) Program
  - Eco-Approach and Departure at Signalized Intersection
  - Connected Eco-Driving
  - Eco-Integrated Corridor Management
  - Dynamic Eco-Routing
- Vehicle-to-Infrastructure (V2I) Communications for Safety



# USDOT Connected Vehicle

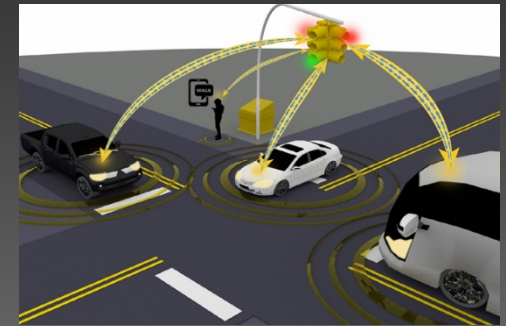


# What is Our Product?

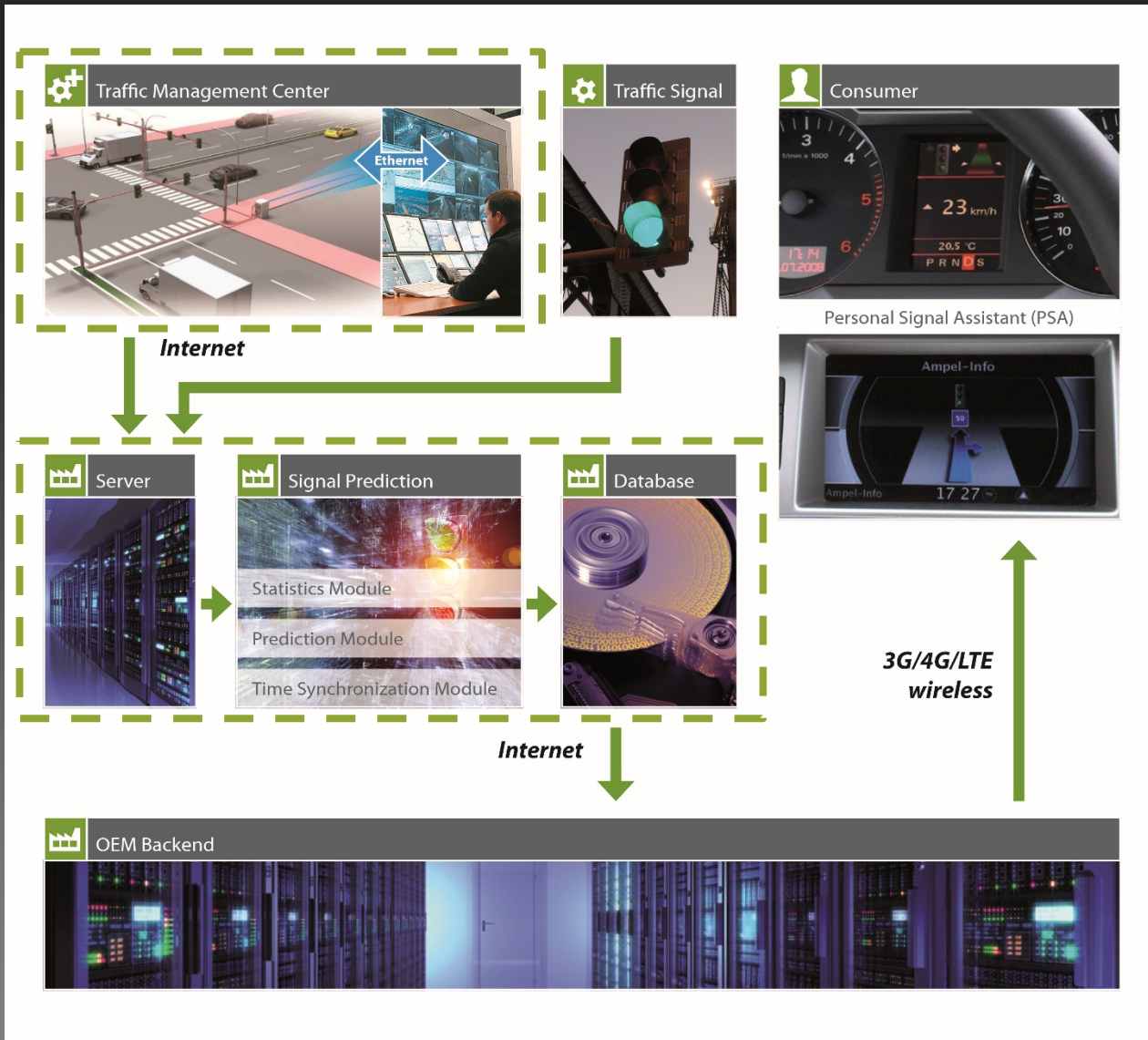
- Personal Signal Assistant
  - SPaT (Signal Phasing and Timing) message
    - current signal status
    - predicted signal switch times
    - SAE J2735 compliant
  - MAP message
    - lanes
    - phase assignments
    - speed limits
    - SAE J2735 compliant
  - Custom Delivery or API

# How Does It Work?

- Works with all traffic signal technology, hardware
- Uses standard ITS communication infrastructure and data protocols
- Limited bandwidth footprint from TMC/intersection to TTS servers
- Customer transmits to vehicle or mobile device via 3G/4G/LTE wireless data communication



# How Does It Work?



# How Does It Work?

- 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
    - Phase call
  - Current:
    - Signal state
    - Phase calls
- Output
  - Next two switches for each signal
    - Red to green
    - Green to red



# What Does It Require?

- Offline data
  - Signal timing and phasing
- Real-time data
  - Actuated signals
    - Phase active status (red, yellow, green)
    - Phase call status
    - Active timing plan
    - Cycle second
    - Preemption or transit signal priority
  - Fixed time signals
    - Active timing plan
    - Cycle second

# Applications

- Automotive Industry
  - Integrated messages, information into dashboard
  - Telematics: Start/Stop technology
- Commercial Fleets, Private Apps
  - Integrated into routing services
  - Telematics
- Transit Operators
  - OBE for loading periods, departure windows
  - Telematics

# Audi Application Example<sup>1</sup>

- Approach on red
  - Remaining time exceeds approach time with min speed advisory
  - Engine automatically shuts off and turns back on when remaining timer reaches 5 seconds
- Approach on red
  - Remaining time less than approach time at speed limit
  - Speed advisory set to avoid stopping
- Approach on green
  - Speed advisory set to local speed limit



# THE VEHICLE

ATLIS 2014



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- FIG\_01
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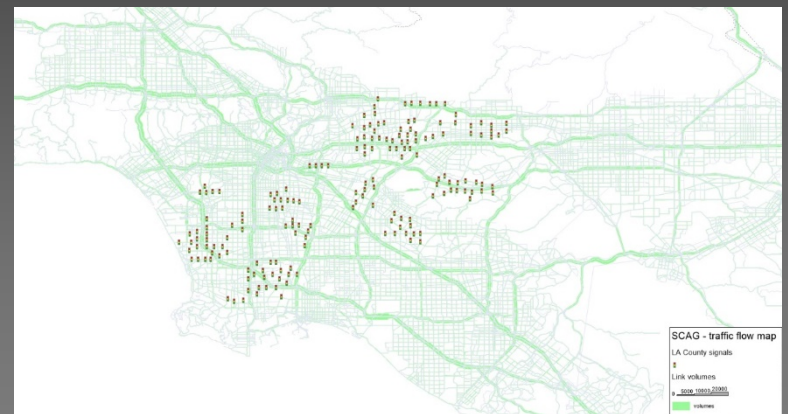
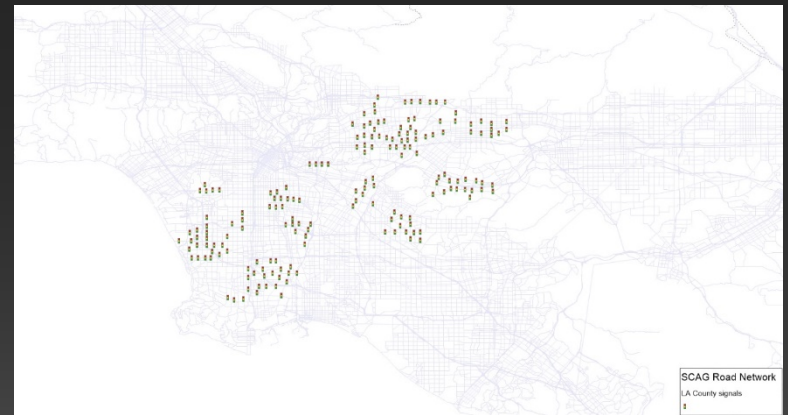
# Deployment Areas

- Washington, DC
- Los Angeles, CA
- New York City
- San Francisco, CA
- Miami, FL
- Las Vegas, NV
- San Diego, CA
- Portland, OR
- Minneapolis, MN

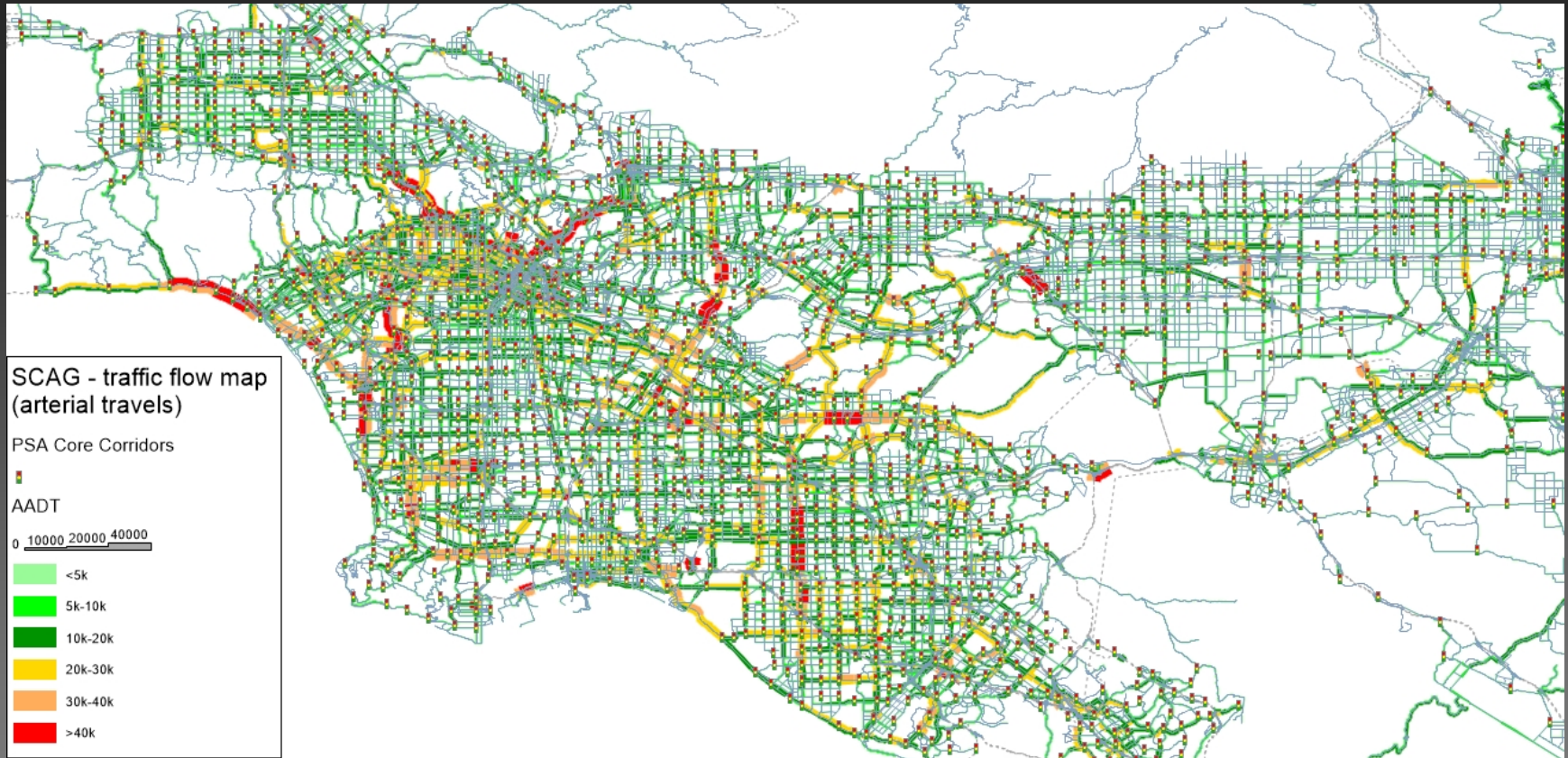


# Corridor Prioritization

- Traffic flow analysis from SCAG model
- If all LA County signals brought online, 7% of total urban travelers will benefit
- If all Corridor signalized intersections are online, 72% of total urban travels will benefit



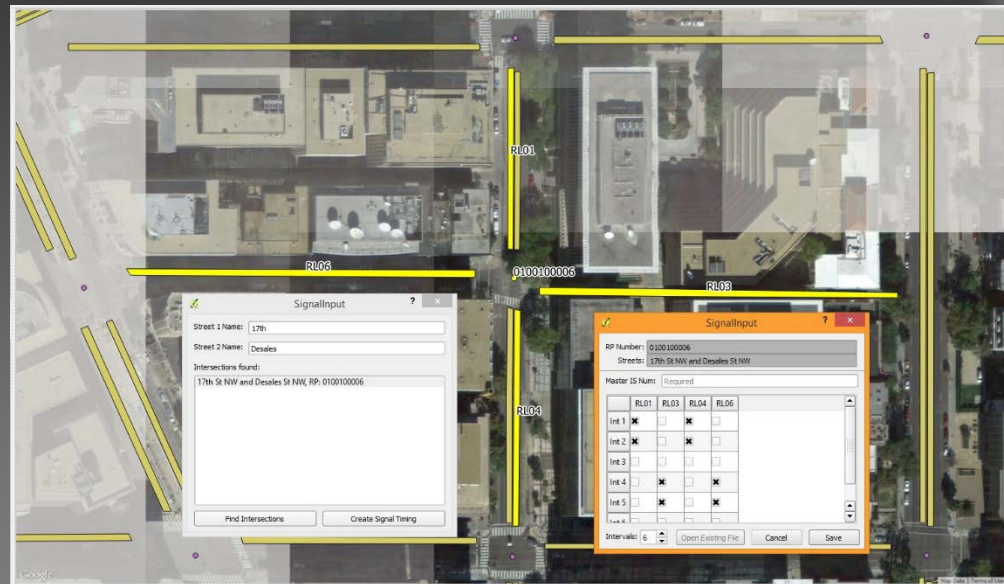
# Corridor Prioritization





# Agency Benefits (1)

- Georeferenced lane, phase topology inventory for all connected signals
  - Data for other tools or DSRC applications
  - MAP format
  - SAE J2735 compliant
  - Interface to GIS



# Agency Benefits (2)

- Signal Operations Reports
  - Communication downtime
  - Time in offset seeking
  - Detector faults
  - Max times
- Signal Performance Reports
  - Delay
  - Number of stops
  - Arrivals on green/red

# Public Benefits



- Save Fuel & Energy

- Automatically turn off engine during red
- Adjust speed to arrive on green
- Reduce consumption and emissions; examples 10-15% savings from field and simulation



- Save time

- Optimize routing based on anticipated signal delay



- Improve safety

- Provide more information to the driver
- Integration into DSRC V2V

# Advantages Over DSRC Solution



- No Prediction
  - Current Connected Vehicle demonstration test beds use DSRC to communicate switch times
  - Current controller firmware products do not predict switch times



- Cost / Benefit
  - Currently no cost effective solution exists for more than 350,000 existing signals
  - Nationwide DSRC coverage expected to be years off given high infrastructure retrofit expenditure
  - Automotive Industry will have DSRC by 2020

# Liability Mitigation



- Provide assistance to the driver without adding any distraction
  - Direct integration into vehicle's human/machine interface developed by HMI professionals
- Hide time to red countdown timer during last 2 seconds to force drivers to look at actual signal and not rely on displayed counter<sup>1</sup>
- Only display speed limit when approaching on green to not provide motivation for speeding
- Data licensing agreement that clearly shields agency from all claims

# What's Required for Agency

- Central system or ATMS supporting real-time connection to signals, or signals connected to local or private network on fiber or high speed serial
- Ability to work with IT departments to secure connections, firewalls
- Provide signal timing data initially during setup stage

# Next Steps

- 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

**THANK YOU!**

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