Personal Signal Assistant…

…bringing the traffic signal into the vehicle…

Traffic Technology Services

- Technology firm specializing in providing Connected Vehicles content to automotive manufacturers, OEM, 3PL
- 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
- North American company incorporated in Delaware with head office in Oregon

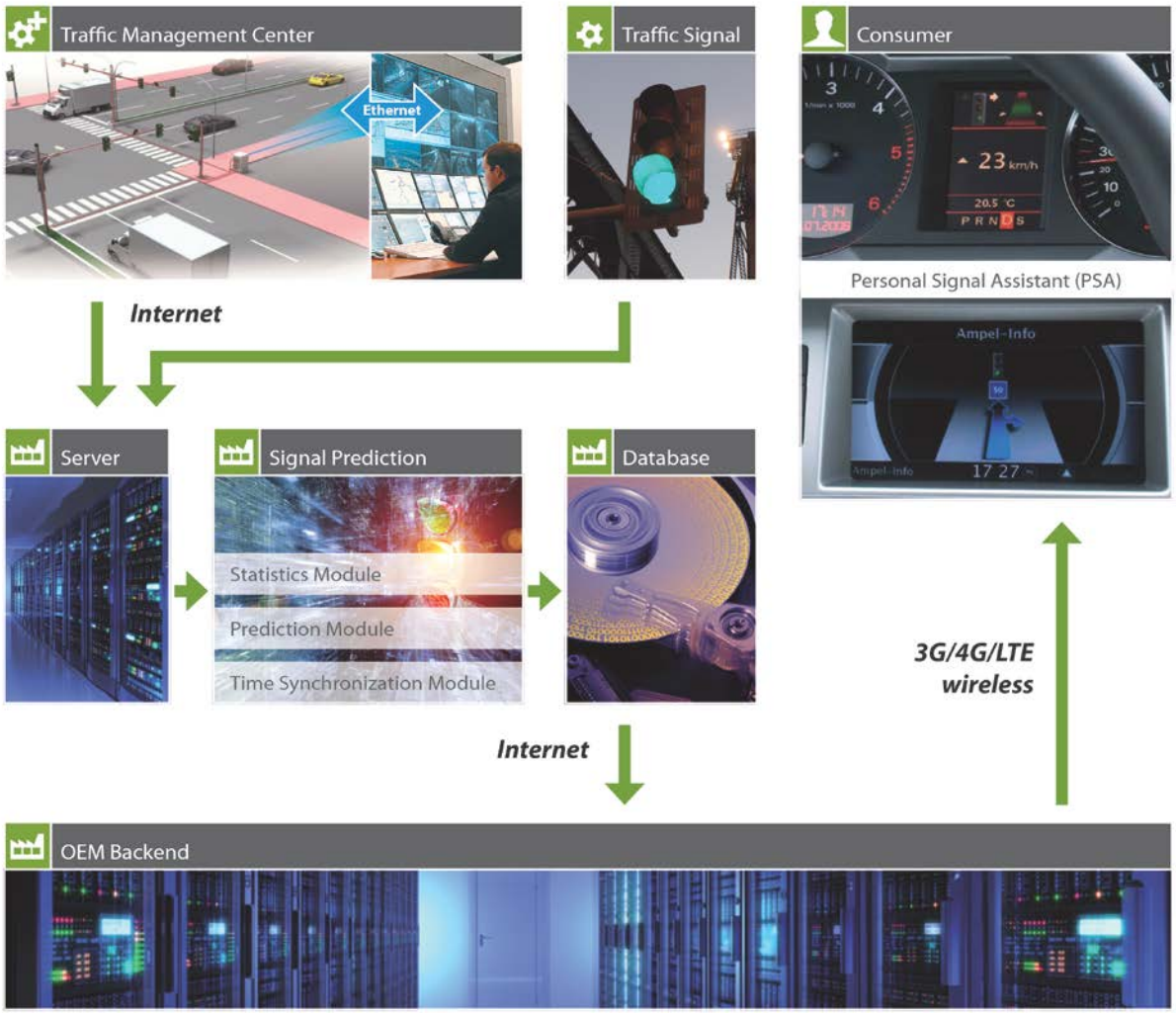
What is Our Product?

- Personal Signal Assistant
  - SPaT (or equivalent) message
    - current signal status
    - next predicted switch times

Personal Signal Assistant

- Fuses proven technology with new analytics
  - Works for all signal technology
  - Uses standard ITS communication infrastructure and data protocols
  - Retrieves signal status in real-time
  - Predicts next switch times
  - Transmits to vehicle or mobile device via internet and 3G/4G/LTE wireless data communication

How Does It Work?



What Does It Require?

- 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
- Offline data
  - Signal timing and phasing

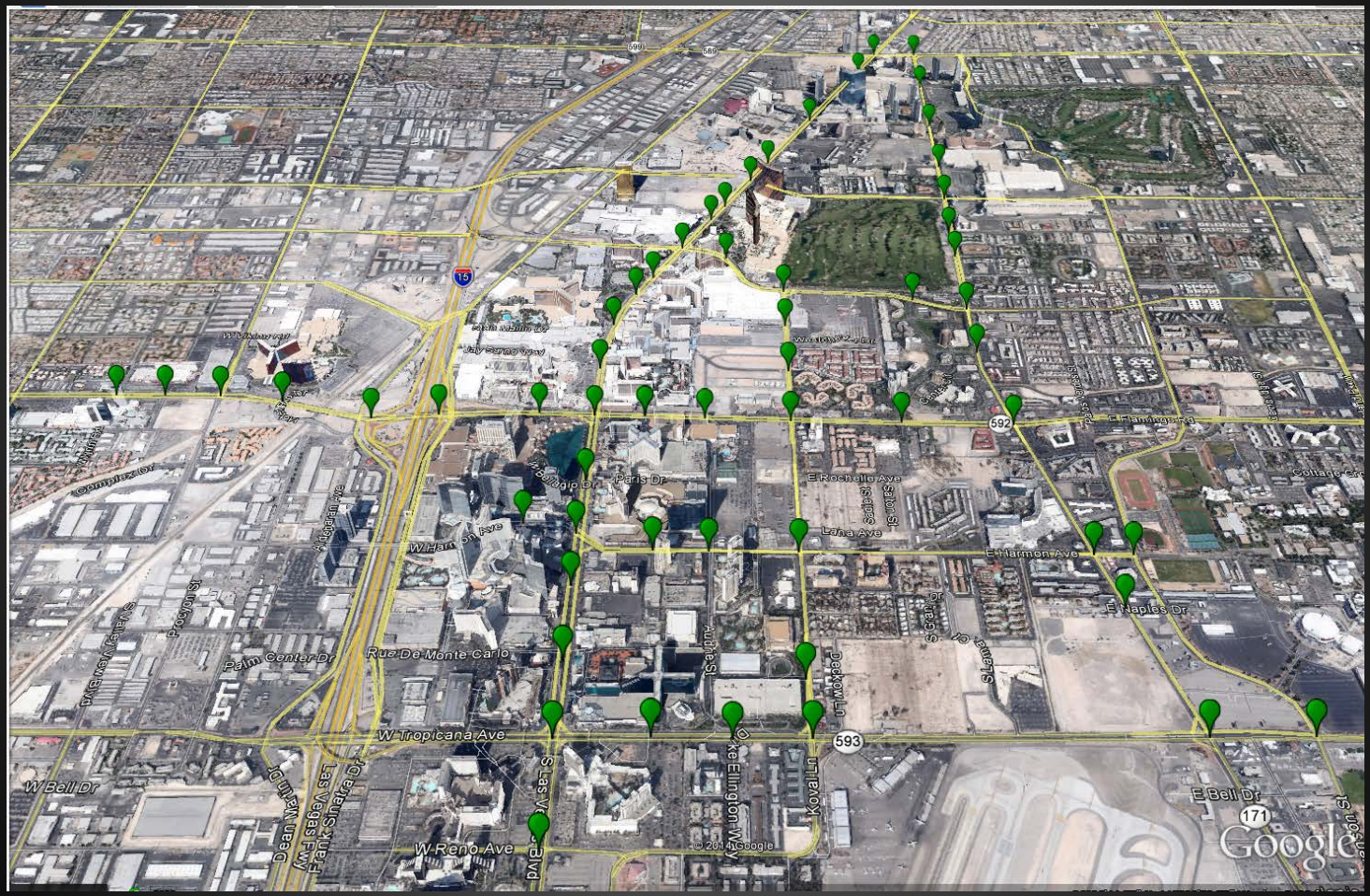
How is PSA Used?

- Automotive Industry
  - Integrated messages, information into dashboard
  - Start/Stop, Auto Start technology
  - Existing App technology
- Commercial Fleets, Courier Services
  - Integrated into routing services
  - Start/Stop, Auto Start technology

Demonstration Deployments

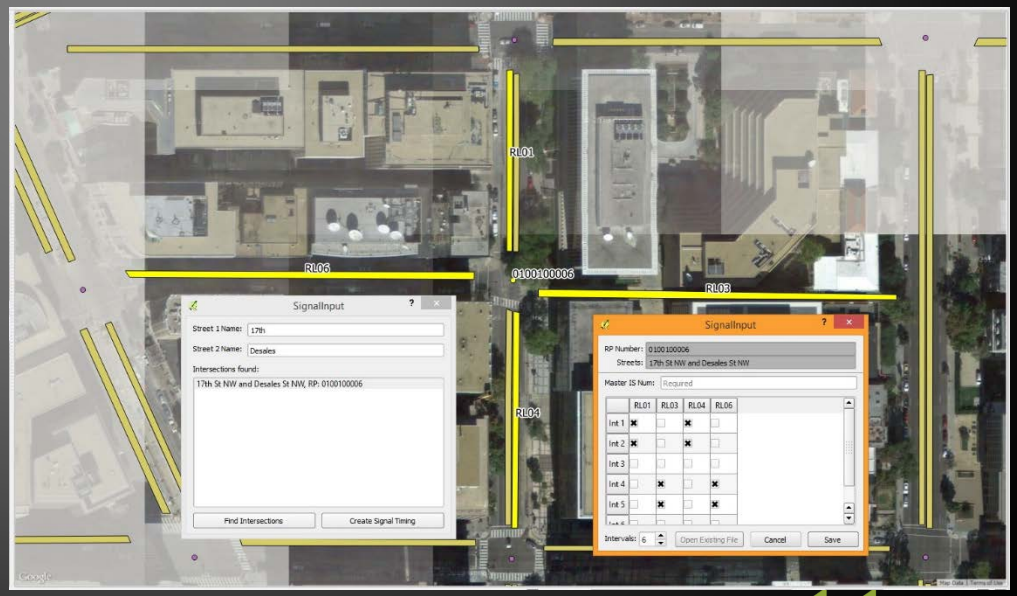
- Las Vegas, NV
  - 50 signals
    - Semi-actuated operation
    - Siemens NextPhase (36) and Trafficware (14) signal controller
    - AB3418 (23), NextPhase40 (13) and NTCIP (14) communication protocol
  - 24/7 operation since April 2013
  - Joint deployment with Audi
- Route NJ 1, Middlesex County, NJ
  - 10 signals
    - Semi-actuated control
    - Trafficware signal controller
    - NTCIP communication protocol
  - Expected operation by early 2015
  - Joint deployment with BMW
- Dortmund, Germany
  - 1 signal
    - Semi-actuated control
    - Siemens signal controller
  - Completed in Fall 2014
  - Technical proof-of-concept

Las Vegas Network



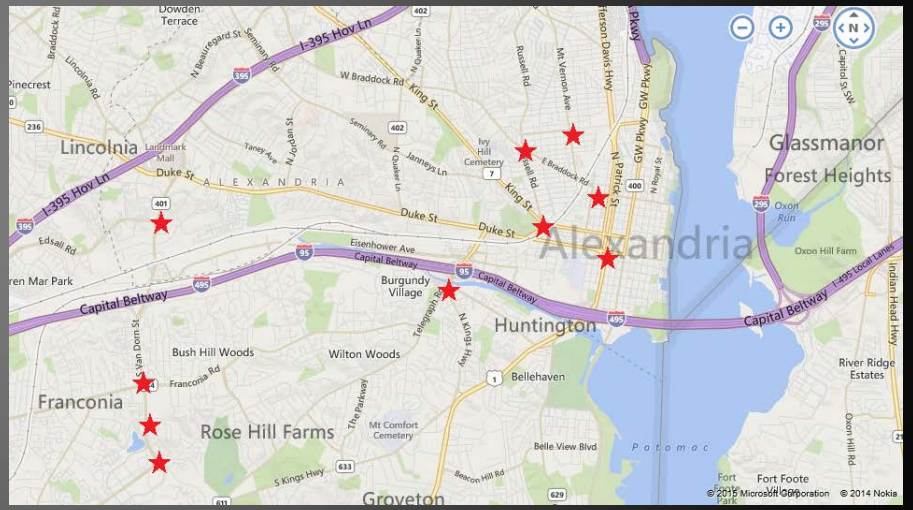
Agency Benefits (1)

- Georeferenced lane, phase (interval) topology inventory (KML) for all connected signals
  - Interface to other GIS
  - Data for other tools
  - MAP format



Agency Benefits (2)

- Signal Performance Report (Quarterly)
  - Metrics
    - Delay
    - Number of stops
    - Split failures
    - Arrivals on green
  - Filter
    - By Movement
    - Hourly (weekday/weekend)
  - Data source
    - GPS probe and signal phase status



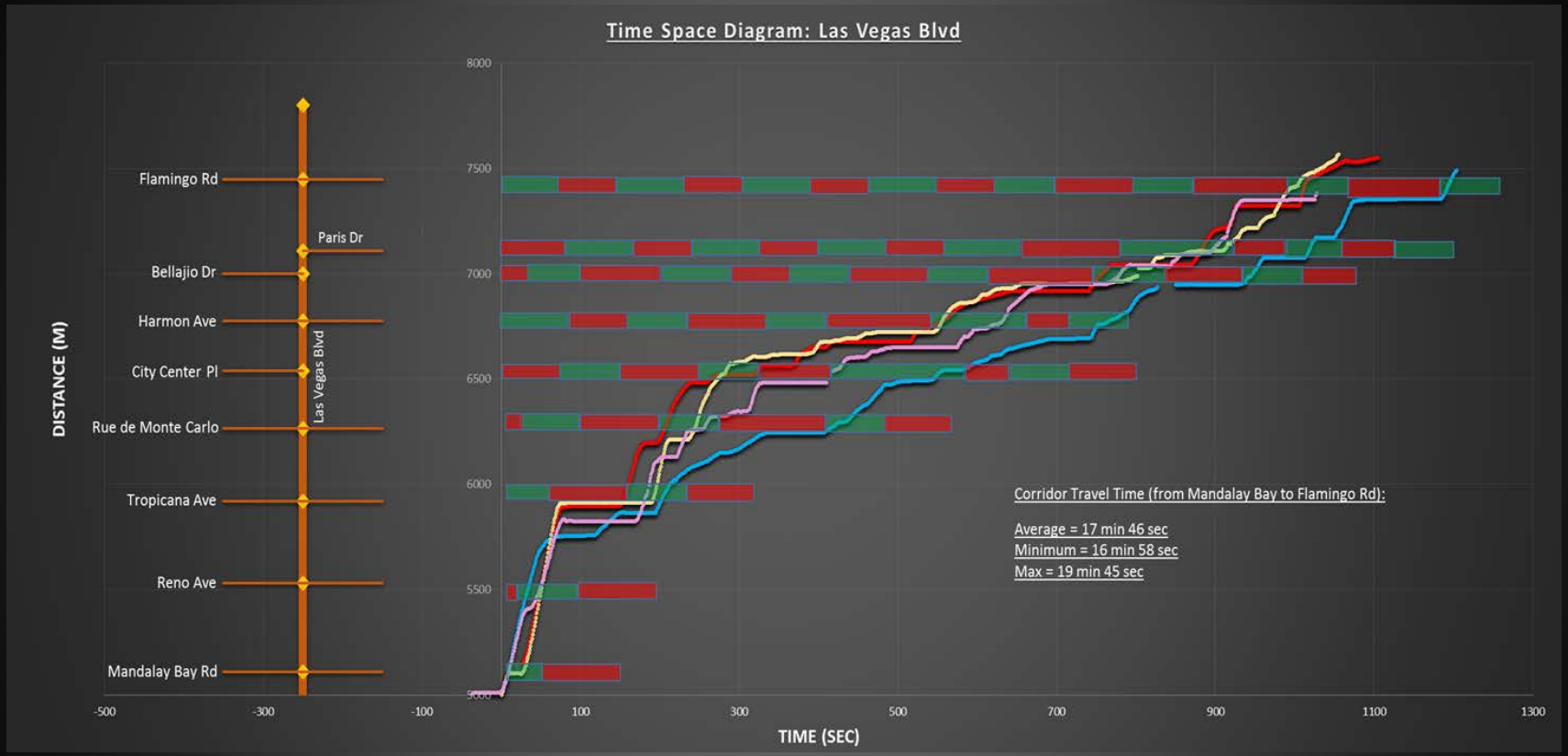
Agency Benefits (3)

- Signal Operations Report (Quarterly)
  - Metrics
    - Communication downtime
    - Time in offset seeking
  - Filter
    - Hourly (weekday/weekend)
  - Data source
    - Signal operations status

Optional Agency Benefits

- Corridor Performance Report
  - Metrics
    - Travel time
    - Signal progression quality (time-space diagram)
  - Filter
    - User selectable
  - Data source
    - GPS probe and signal phase status

Optional Agency Benefits



- TTS provides agency with performance reports including time-space diagrams for selected corridors

Benefits of Predicting the Traffic Signal State

- Save fuel
  - Automatically turn off engine during red
  - Adjust speed to arrive on green
  - Reduce consumption and emissions

- Save time
  - Optimize routing based on anticipated signal delay

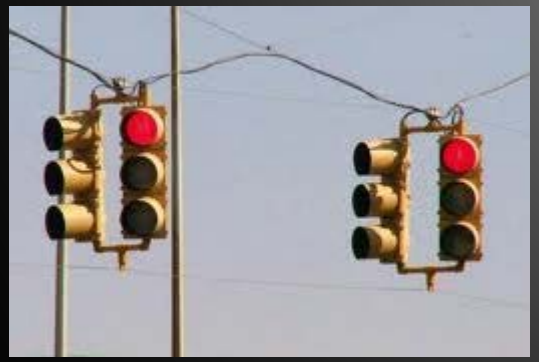
- Improve safety
  - Provide more information to the driver

Other Benefits

- Potential to work with other OEM to extend technology to Agency transit services
- Potential to use technology with other Civil services
- Potential to work with Navigation apps used by other system users
- Expand interconnected signals to central control system

Advantages Over DSRC Solution

- New Traffic Signals
  - Current Connected Vehicle demonstration test beds use DSRC to communicate expected switch times to approaching vehicles
  - Expensive hardware solution
  - Current controller firmware products cannot predict switch times



- Existing Traffic Signals
  - 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

Awareness of Liability Potential

- Provide assistance to the driver <u>without</u> 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[1]
- Only display speed limit when approaching on green to not provide motivation for speeding
- Data licensing agreement that clearly shields agency from all claims

[1] As implemented by Audi for CES 2014.

What We Need

- Signal timing plan documents or data
- Permission to retrieve and use signal timing data
- Accommodation of minimal hardware at TMC per recommendation by signal vendor or ITS consultant

Next Steps

- Identify Agency lead/champion
- Enter MOU with TTS
  - Data access
  - Identify hardware/software requirements
- Provide offline signal timing data
- Deploy communication server solution
- Demonstrate system for approval
- Enter Agreement with TTS
  - Operations
  - Maintenance

THANK YOU!

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