Technology Introduction
We
Predict
Traffic Control
Red light, green light: New Audis will predict the time until that stoplight turns green

By Jacob Bogage  August 15

No one likes sitting at red lights. Now these cars will tell you how long you’ll be waiting. (Martin Leissl/Bloomberg News)

Waiting for a green light is perhaps the worst of all driving frustrations. You’re sitting there idling behind some station wagon, there’s nothing but commercials on the radio and when, dear God, will this traffic light change colors so I can inch my way onward?

Source: Dallas News

Source: The Washington Post
Audi Traffic Light Information

This feature is not a substitute for attentive driving. Always pay careful attention to the road and obey all speed and traffic laws. Requires compatible traffic infrastructure which is not available in all areas, and an active Audi connect PRIME subscription. Not available on vehicles built prior to June 1, 2016. See Owner’s Manual for further details, and important limitations.
About TTS

• International technology firm specializing in content for connected vehicle applications and services

• Expert team of traffic engineers, data scientists, and programmers
  • Team of 30+ full-time employees
  • Global subject matter expert reputation
  • Inventors of core technology with patent

• North American company incorporated in Delaware with head office in Portland, Oregon

• European subsidiary based in Munich, Germany
Key Takeaways

• Information supplier
  • Cloud based

• Bridging the gap between infrastructure and vehicle
  • Work with public agencies (Suppliers)
  • Established vendor relationships (Partners)

• Predict the signal change (Patent)
  • Traffic signal controllers do not do this

• Industry standard product
  • SAE J2735

• Customers implement connected vehicle applications
  • Audi, BMW, Continental

• Something in Return
  • Suppliers receive performance metrics back from Customers
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

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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

• Audi vehicle models, released in 2016, support connected vehicle applications using TTS data

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What Is Our Product?

• Personal Signal Assistant
  • Cloud-based service
    • SPaT message
      • Current signal status
      • Predicted signal switch times
      • Emergency vehicle preemption / public transit priority
      • Protected/permissive operations
    • MAP message
      • Lanes, geometry, stop bar locations
      • Phase assignments
  • SAE J2735 protocol, compliant
  • Customers access data via API or other sharing services
  • Peer-to-peer communication to customer backend
What is Our Product?

• MAP messages are GIS
  • Polygons to represent details of the intersection
  • Signal phase matched to movement
  • All details of the intersection are stored
Standard SAE J2735

- SAE J2735
  - Recently revised (2016-03-30)
- Focuses on DSRC (5.9GHz), but also accommodates cellular (3G/4G/LTE) or other wireless communications
- Message set “designed, to the extent possible, to also be of potential use for applications that may be deployed in conjunction with other wireless communications technologies.”
- Amendments motivated to update MAP and SPaT
- To reflect experiences in pilot and field tests from US, Europe and Japan
What is Our Product?

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Relationships

- Suppliers
  - City DOT
  - County DOT
  - State DOT
  - Econolite
  - McCain
  - Siemens
  - Trafficware
  - Transcore
  - ATMS System

- Partners
  - Auto OEM, Tier 1
  - Truck OEM, Tier 1
  - After-Market
  - Transit
  - Commercial Fleets
  - Insurance

- TTS
  - Customers
    - Audi Connect
    - Connected Service
  - End Users
    - Suppliers own data, as by-products of the infrastructure
    - Partners deliver the data from ATMS, based TTS’ API
    - TTS connects the systems, develops the information, and delivers the data product
    - Customers develop and provide the connected vehicle applications
    - End Users are consumers

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Communications Flow

- Local Traffic Signals
- City/Region Agency

**Signal Predictions**
- Traffic Technology Services receives signal data
- Provides MAP message (detailed map of intersection)
- Provides SPaT Message (current signal status, predicted signal switch time, confidence of prediction)

**MAP Messages**

**TTS Data**
- Service Authentication
- Token Validation

**Automotive OEM**
- OEM backend system and vehicle receives authentication token
- Once validated, OEM system sends MAP and SPaT messages to vehicle

- Information displayed only if high confidence in timeliness and accuracy of prediction

City/Region provides raw traffic signal data
Provides as-built and signal control data
Value

• MAP generation
• Prediction of signal state changes
  • Current status (s0, remaining red = 32 seconds)
  • Next status (s1, green = 45 seconds)
  • Next status (s2, red = 37 seconds)
• Data fusion based on:
  • Current status
  • Plan information
  • Historical results
• Experience working with OEMs
Many Applications

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BMW Application Example

- Approach on red
  - Remaining red time countdown of signal phase provided in Infotainment display
- Start-up on green
  - Remaining green time shown
- BMW informational video
  - https://youtu.be/WdGc0BKMvUA?t=372
  - https://youtu.be/pAsfEwBTVmM

1 As demonstrated by BMW at CES 2017.
The End Result
Audi Application Example

• Approach on red
  • Remaining red time countdown of signal phase provided in HMI display

• 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

• Audi informational video

\(^2\) 2017 Q7, 2017 A4 and 2017 A4 Allroad.
The End Result
Continental Application Example

• Approach on red
  • Automatic Recuperation
    • Recuperation/regeneration of batteries
    • Suggestion by system to apply brakes
    • Automatic engine start 1 sec before green

• Approach on green
  • Coasting
    • If slower speed would be more efficient, the accelerator pedal vibrated

• Efficiency gains
  • 3-4% additional fuel savings on top of benefits from 48V hybrid alone

• Continental Press Release

3 As demonstrated by Continental at CES 2016.
The End Result
In The Consumers Eye

- Save Fuel & Energy
  - Start-Stop technology automatically turns off engine during red
  - Regeneration from braking in hybrid vehicles
  - Measurements show 10-15% savings
- Save time
  - Optimized routing based on current or anticipated signal delay
- Comfort
  - Adjust speed to arrive on green, less stopping
- Improve safety
  - Provide more information to the driver
  - Integration into DSRC V2V

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Agency Benefits

• 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
What’s Required

• 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
How to Get Started

• 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
Next Step

- Data agreement
- Permission to access and use signal timing data
- Limitation of liability
- Indemnification

Authorization for TTS Access to Agency Traffic Signal Data

This is an agreement between the State of Oregon acting on behalf of its Oregon Department of Transportation ("ODOT") and Traffic Technology Services, Inc. (TTS). ODOT and TTS are sometimes referred to in the agreement as “Parties” and both ODOT and TTS are sometimes referred to in this Agreement together as “Parties”.

Whereas, ODOT is in the business of developing technologies, strategies, and systems for use in maximizing the efficiency of transportation and users and thus the overall capacity of existing transportation networks;

Whereas, ODOT collects Real Time Traffic Signal Data as more specifically described in the attached Exhibit 1;

Whereas, TTS has a significant business interest in accessing to Real Time Traffic Signal Data as the input into its proprietary and patent pending processes;

Whereas, ODOT data may be made available to TTS at no cost to ODOT;

Whereas, ODOT data are not confidential, nor identify any transportation end user specifically in any manner;

Whereas, TTS agrees to provide related GIS inventory and signal performance metrics in exchange for access to these data, and

Whereas, TTS desires permission to obtain access to the Real Time Traffic Signal Data for use in conjunction with its business.

Now therefore, ODOT and TTS agree as follows:

Definitions:

"ODOT Data" means collectively, Real Time Traffic Data, Traffic Signal Timing Plan, and any other data provided to TTS by ODOT under this Agreement.

"Real Time Traffic Data" means signal status and states, demand status and states, and other information available from traffic signal controller or ODOT’s Central Signal System.

"Traffic Signal Timing Data" means signal timing plans, existent intersection design, traffic signal plans, signal control plans, or other documents that identify the time-of-day plans.

Section 1. Authorized Representatives
Thank You!

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