Cloud-based Connected Vehicle Deployment
Agenda
• **Original Equipment Manufacturers’ (OEMs’)** connectivity needs

• Enabling infrastructure

• How we make it happen
Connected Vehicles ≠ SPaT*

*SPaT = Signal Phase and Timing, as defined in SAE J2735
How we (the transpo. folks) think
How OEM’s think
Comparison of mindsets

<table>
<thead>
<tr>
<th>“Us”</th>
<th>“Them”</th>
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<tbody>
<tr>
<td>Local development</td>
<td>Large-scale deployment</td>
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<td>Wants all vehicle manufacturers</td>
<td>Wants nationwide deployment &amp; consistency</td>
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<td>Average operations are M-Fr</td>
<td>Systems have high availability, 24/7</td>
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<td>An 18 month project is a “short” timeframe</td>
<td>Develops and deploys software in a matter of weeks</td>
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<td>Develops and implements projects</td>
<td>Provides solutions, not necessarily wholly owned by OEMs</td>
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The problem

"The Chicken - or - The Chicken Egg"
Agenda

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3 Major Components

- The Car: provides the application
- The Cloud: provides the tech, content & communication
- The transportation infrastructure: provides the raw data
The Car

• Dedicated communication

• **On-board Diagnostics (OBD-2)**

• LED Display

These all enable the **software-defined vehicle.**
Goals of “the cloud”

• High availability & reliability of servers

• Accessible anywhere there is internet

• Secure and scalable
Cloud Communications Flow

On 4G Now

Future
Transportation data infrastructure

- Communications
- Controllers talking NTCIP
- Central ATMS
Agenda

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• How we make it happen
Traditional Technology Procurement Model

Private

Agency

Public

Private

Buys devices based on procurement

Sells devices

Uses devices to achieve public good

Tells agency of public issues
Smart Community Partnership

Public
- Addresses a social concern & sells a service

Private
- Shapes competitive landscape

Agency
- Pays taxes and provides feedback
Overall SPaT Generation Workflow

1. ATMS
2. Database
3. Prediction engine
4. CV applications
SPAT quality control: live status data monitoring – latency & outage

• For example, as a result of product launch in Las Vegas, TTS has been tracking and reporting data latency and outages

• On 1/24, the Las Vegas central software (ATMS.Now) is updated to latest Version2.6
  • 85% percent of time data latency is less than 2 seconds
  • In comparison, latency constantly at 20+ at product launch in Dec 2016 and during CES 2017

• The new version is deployed to other cities that use the same central software system; even better latency performances and stable system operations

• These lessons learned from daily product operation and technical support to existing auto OEM customers make the live data feed better each day

• Product operation and maintenance tracking the data latency and outages
• Partner’s software (ATMS.Now) new release 2.6 on 1/24
SPAT quality control: localization to each online signal

- Localization of the prediction engine to each signal control also involves field testing and validation, because of protected/permissive setup and overlap phases
  - Sometimes these local settings are logically wired in the controllers, so they are not necessarily seen from live data

- **QAQC measure in place: field testing and validation**
  - For each signal, TTS team goes to the field twice: testing and quality check of topology (MAP data) and ensure protected/permissive or overlap phases are coded into the prediction engine and backend system

- These localization results in the most true-to-real world signal status and predictions
  - These are applicable to future autonomous driving as local traffic control rules are reflected in the SPAT as well as the MAP messages.

- A signal in Frisco TX showing an overlap right turn phase (protected); at the same time the left turns are permissive only
Green funnel chart for a signal in Portland area shows the red-green switch prediction across the day; two phases shown here (one is red-green and the other is green-red).
Proven V2I implementation

Step 1 – Provide communication to signals

Step 2 – Procure centralized ATMS

Step 3 – Institute a Trusted Data Portal (TDP)

Step 4 – Manage & maintain 24/7 TDP from TMC
Partnership experience

- TSM&O community has experience with this
- Will involve IT and Legal counterparts
- The potential benefits far outweigh the future uncertainty!
2 methods to institute CV

• Think differently
  • IoT price-tag will cause nonconventional innovations
  • LOS and Congestion issues can be solved in other ways

• Find common solutions, rather than one-off implementations
  • Leveraging existing resources is only possible once agency silos are broken
A need to innovate...

- Reward for proactiveness: a seat at the table to change the future

- Tomorrow’s problems do not always require a civil solution

- 40,000 yearly fatalities are still occurring
Thank You!

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