Preparing the Infrastructure for Connected Vehicle Deployments
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Connected Vehicle Use Case

Adaptive Signal Control + Emergency Preemption + Transit Priority + Tolling
Connected Vehicle Use Case

2011: World Congress, Orlando FL

Technology Showcase:
- 15 passenger bus with audio tour
- SCOOT Adaptive Corridor on International Drive
- SPAT Broadcast from 10 Intersections
- Tactics Central Traffic System
- Virtual Tolling Zone on International Drive
- Emergency Preemption on Universal Drive
- Bus Rapid Transit on Universal Drive
Connected Vehicle Use Case

2011: World Congress, Orlando FL

5.9 GHz Dedicated Short Range Communication

Basic Safety Message

On-Board Equipment

Roadside Equipment

Vehicle Mobile Terminal

Police/Fire/EMS or Transit

On-Board Equipment

Normal Traffic

Signal Controller
Connected Vehicle Use Case

2011: World Congress, Orlando FL

On-Board Equipment

Vehicle Mobile Terminal

Police/Fire/EMS or Transit

On-Board Equipment

Signal Request Message

5.9 GHz Dedicated Short Range Communication

Signal Request Message

Preempt Input

Roadside Equipment

Emergency Vehicle Alert

On-Board Equipment

Normal Traffic

Signal Controller
Connected Vehicle Use Case

2011: World Congress, Orlando FL

On-Board Equipment

Vehicle Mobile Terminal

Police/Fire/EMS or Transit

Map Message

5.9 GHz Dedicated Short Range Communication

Map Message

Basic Safety Message

Emergency Vehicle Alert

On-Board Equipment

Normal Traffic

Roadside Equipment

Map Message

Map Message

Map Message

Signal Controller
Connected Vehicle Use Case

2011: World Congress, Orlando FL

On-Board Equipment

Signal Status Message

5.9 GHz Dedicated Short Range Communication

Signal Status Message

Roadside Equipment

Preempt Status

Vehicle Mobile Terminal

Police/Fire/EMS or Transit

Emergency Vehicle Alert

On-Board Equipment

Normal Traffic
Connected Vehicle Use Case

2011: World Congress, Orlando FL

On-Board Equipment

Signal Phase And Timing

5.9 GHz Dedicated Short Range Communication

Roadside Equipment

Signal Phase And Timing

On-Board Equipment

Emergency Vehicle Alert

Normal Traffic
Connected Vehicle Use Case

2011: World Congress, Orlando FL

- On-Board Equipment
- Roadside Equipment
- Vehicle Mobile Terminal
- Police/Fire/EMS or Transit
- On-Board Equipment
- Normal Traffic

5.9 GHz Dedicated Short Range Communication

- Tolling Message
- Basic Safety Message
Connected Vehicle Use Case

2011: World Congress, Orlando FL
Connected Vehicle Use Case

Transit message is sent from onboard equipment to roadside equipment

If the vehicle is slightly behind schedule, the green light is extended

If the vehicle is greatly behind schedule or an evacuation plan is in effect, the SCOOT adaptive system implements Strategic Transit Priority by controlling the signals to meet the transit plan instead of traffic plans
Connected Vehicle Model Deployments

USA. EU. UK
Connected Vehicle Deployments

2013: Model Deployment Ann Arbor MI

Adaptive, Parallel Railroad, Far-Side Transit Stop
Siemens Connected Vehicle Deployments

2013 – 2016: Cooperative ITS Corridor Joint Deployment, Vienna to Rotterdam

- SPAT, MAP, BSM, SRM, SSM
- Siemens RSE Transparent
- J2735
- EU OBE

Use Cases:
- Transit Signal Priority
- Emergency Preemption
- Red Light Warnings
- Probe Data
Siemens Connected Vehicle Deployments

2012: San Antonio VIA PRIMO System

Traffic Management Center

City Fiber

SPAT

Priority

Transit Priority Software

Bus Schedules

Bus Locations

Transit Zone Locations

Traffic Management Center

BUS OBE

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Siemens Connected Vehicle Deployments

Affiliated Test Beds in USA & J2735 Reconciliation Committee: EU, JP, UK, USA

Use Cases:
- Transit Signal Priority
- Emergency Preemption
- Red Light Warnings
- Probe Data
Connected Vehicle Infrastructure Preparations and Funding
NHTSA Milestones
Preparing the Infrastructure for Connected Vehicle

Connected Vehicle Milestones and Funding

2 February 2012 Press Release:

“The head of the USA's National Highway Traffic Safety Administration David Strickland to make decision on ‘connected vehicle’ legislation in 2013”

“…did not address the cost of developing and paying for infrastructure…”

2013: NHTSA decision for Light Vehicles

2014: NHTSA decision for Heavy Vehicles

2015: Guidelines for Roadside Equipment and Infrastructure
## Preparing the Infrastructure for Connected Vehicle

### 2010: Deployment Analysis Findings: Controller Types by Technology

<table>
<thead>
<tr>
<th>Line</th>
<th>Controller Type</th>
<th>Speed</th>
<th>Comm</th>
<th>OS</th>
<th>API</th>
<th>In Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ATC 5.2b</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>8,000</td>
</tr>
<tr>
<td>2</td>
<td>Model 2070LX</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>&gt; 1,000</td>
</tr>
<tr>
<td>3</td>
<td>Model 2070E</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>&gt; 1,000</td>
</tr>
<tr>
<td>4</td>
<td>Model 2070L</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>52,000</td>
</tr>
<tr>
<td>5</td>
<td>NEMA, Modern</td>
<td>Yes</td>
<td>Yes</td>
<td>33%</td>
<td>No</td>
<td>36,000</td>
</tr>
<tr>
<td>6</td>
<td>NEMA, Legacy</td>
<td>No</td>
<td>Adaptor</td>
<td>Yes</td>
<td>No</td>
<td>91,000</td>
</tr>
<tr>
<td>7</td>
<td>Type 170, Modern</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>12,000</td>
</tr>
<tr>
<td>8</td>
<td>Type 170, Legacy</td>
<td>No</td>
<td>Adaptor</td>
<td>No</td>
<td>No</td>
<td>102,000</td>
</tr>
<tr>
<td>9</td>
<td>Electromechanical &amp; Other</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>6,000</td>
</tr>
<tr>
<td></td>
<td><strong>Total:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>307,000</strong></td>
</tr>
</tbody>
</table>
## Preparing the Infrastructure for Connected Vehicle

### 2010: Deployment Analysis Findings: Controller Upgrades for Connected Vehicle

<table>
<thead>
<tr>
<th>Line</th>
<th>Controller Type</th>
<th>Upgrade Necessary for RSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ATC 5.2b</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Model 2070LX</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>Model 2070E</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>Model 2070L</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>NEMA TS-2 Ethernet (modern)</td>
<td>Standard OS (33%): None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-Standard OS (67%): Port App, Cross-compile, Test</td>
</tr>
<tr>
<td>6</td>
<td>NEMA TS-1 (legacy)</td>
<td>Replace Controller</td>
</tr>
<tr>
<td>7</td>
<td>Type 170 controllers (modern)</td>
<td>Port App, Cross-compile, Test</td>
</tr>
<tr>
<td>8</td>
<td>Type 170 controllers (legacy)</td>
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</tr>
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<td>Replace Controller</td>
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### 10% Per Year Replacement of Non-CV Controllers

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<td>8</td>
<td>Type 170 controllers (legacy)</td>
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<td>Electromechanical controllers</td>
<td>Replace Controller</td>
</tr>
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### 10% Per Year Ramp-Up of CV-Equipped Intersections
Preparing the Infrastructure for Connected Vehicle

**Added Cost of CV Intersection Kit**

- **(3) Antennas**
  - 5.9 GHz
- **(3) Antenna Cables**
  - 1 Meter
- **Lightning Protectors** (Optional, sold separately)
- **Mounting Bracket Panel, DIN or Pole**
- **Roadside Equipment**
- **(2) Ethernet Cables**
- **From Traffic Controller**
- **(2) RJ-45 Connectors**
- **Power over Ethernet Outdoor CAT-5 Cable**
  - (Sold separately, 20 Meter min order)
- **Power Injector**

**Ordering Information:** MBV16827-001
Preparing the Infrastructure for Connected Vehicle

Total Cost of Ownership per Intersection:

$ New controller (if needed)  
+ $ Controller installation (zero if done during routine maintenance)  
+ $ RSE  
+ $ RSE Installation  
+ $ Connected Vehicle Software Application License Fee  
- $ Proprietary Emergency Vehicle Transponders  
- $ Proprietary Transit Signal Priority Transponders  
- $ Video Detection Equipment and Maintenance  
- $ Loop Detection Equipment and Maintenance  
- $ A portion of Accident Investigation and Litigation  

= $ Total Cost of Ownership
Preparing the Infrastructure for Connected Vehicle

Paying for Connected Vehicle: Cost Share of Existing Budgets

• Replace non-standard controllers with:
  • 2070 & TS-2 for SPAT, Preempt, Transit
  • ATC 5.2b for multiple apps i.e. Travel Time

• Phase out special-purpose Roadside Equipment

• Cost-share CV Roadside Equipment among agencies
  • Emergency Preemption app
  • Bus Rapid Transit app
  • Truck / Automatic Vehicle Location app

• Consider total cost of ownership in long-term planning:
  • Fewer collisions and litigation
  • Installation and maintenance of single standard roadside device
  • Migration away from loop, magnetic and video detection to CV apps
  • Signal control based on vehicle priority and arrival, not signal timing
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